A CRITICAL REVIEW OF THE NATIONAL MALARIA ERADICATION PROGRAM OF INDIA

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The Regional Office of the World Health Organization loaned to the team Mr. James Thomson, Sanitary Engineering Malaria Consultant in the Delhi office, for a period of two weeks for a tour of four States. His broad experience contributed much to the quick review of these areas.

IMPRESSIONS AND RECOMMENDATIONS

1. The spraying operations carried out to-date during the attack phase, constituting the principal pillar of the eradication structure, are impressive chiefly in their magnitude. Some Units—very limited in number—have demonstrated that complete and uniform applications of insecticides can be accomplished with the personnel and equipment available. However, the spraying operations have not generally attained the desired precision in (a) treatment of all existing houses or (b) uniform coverage of sprayable surfaces in the individual houses and associated structures. **The team believes that the benefits of residual insecticidal coverage can be more fully exploited by meticulous attention to all details of spraying operations.**

2. **Senior and Junior Assistant Unit Officers must personally ensure, through inspection of the spraying work in even the most remote parts of their jurisdiction, that all of the houses in all of the existing towns, villages and hamlets are being properly sprayed.** Senior and Junior Malaria Inspectors, in addition to the high academic qualifications which have been noted, must possess enthusiasm for, and exhibit dedication to, the painstaking overseeing of every aspect of the spraying operations.

3. Less-than-complete coverage of many villages and less-than-complete treatment of sprayable surfaces within individual houses are frequently occurring because many houses are locked or because the householders, for many reasons, refuse to permit spraying. The Team does not minimize the gravity of these problems, but feels that many field personnel are too inclined to accept them as excuses for superficial coverage of houses and villages. **It is recommended that senior Unit personnel intervene directly at the village level to distinguish between those refusals which can be resolved immediately and those which may require special or prolonged effort.**

4. The NMEP has recognized that various Units whose jurisdictions include 1,000,000 inhabitants or more are working in terrain of highly variable difficulty. Sanction has been given certain "difficult" Units to reinforce the field staff by 50 per cent or 100 per cent so that total coverage may be achieved. The team has observed that a few Units in several States are operating in such hilly terrain, with such dispersed housing, that the spraying rounds are not even being completed with the authorized increases in staff. In such territory the proper supervision of widely scattered spraying squads is also very difficult. **The Team recommends that such special situations be met by authorizing still further**

reinforcement of personnel, preferably through the increasing and re-definition of Units, each with a full or increased complement of supervisory personnel. The same objectives might be achieved by limited extension of the spraying operational period in particular Units concerned.

5. The spraying protocols for treatment of individual houses, while obviously varying from State to State according to local housing pattern(s), rather uniformly exclude the spraying of under surfaces of beds, fixed sleeping platforms (such as the "machans" of Assam), tables and shelves which may represent very favorable anopheline resting places. **The Team recommends a review of the probable benefits of spraying such surfaces, especially in areas where the newly-established surveillance casts any doubt on the interruption of transmission by residual insecticide application.**

6. The Team has observed that only limited use has been made of an extremely fruitful and sensitive source of epidemiological information namely, the examination of blood smears obtained from all fever cases encountered in hospitals, primary health centers and other dispensaries. A master plan exists for future national exploitation of this so-called passive survillance but **the Team believes that, insofar as possible, individual Units or States should be directed to institute such service immediately.*** Upon insistence that dispensaries obtain blood smears from all fever cases, **the malaria service must recognize its obligation for immediate examination of these slides and furnishing of the results.**

7. Active surveillance has, with few exceptions, been delayed by six or more months in its initiation (target date April 1, 1960) and no significant data will be available during the 1960 transmission season. This, together with failure to reach the spraying goals during the past three years, means that few units can be considered for withdrawal of spraying during calendar year 1961. The cost of these failures is enormous both in the unnecessary extension of spraying and in the fact that no significant data have been obtained during the last few months of calendar year 1960 when active surveillance was being slowly tooled up. **States might well be informed that immediate initiation of complete active surveillance coverage constitutes one of the requisites for participation in the commodity program from the Center.**

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* The Team is gratified to learn that steps have already been taken for dynamic initiation of this activity.

8. State and unit malaria officers in a number of States, while conscientiously emphasizing spraying operations, have apparently not appreciated the surveillance program, presently being implemented, as a refined criterion for safely interrupting insecticidal application or as the index demanding its continuation.

9. **Paramount importance must be attached to the immediate and exhaustive investigation of malaria cases revealed by examination of fever case slides. A positive slide must be considered as prima facie evidence of transmission of malaria until actual proof can be acquired to the contrary,** and no reluctance to classify it as autochthonous is tenable just because no secondary case can be found.

10. The early accomplishment of malaria eradication has been stimulated in India, as in other countries, by the spectre of anopheline resistance to insecticides, a phenomenon which could greatly increase the technical and financial difficulties of the task. The susceptibility level of one of the principal vectors, **Anopheles culicifacies,** has declined seriously in very limited areas which are being increasingly well defined by national and international specialists.

The geographic extension and the level of presently identified anopheline resistance in India do not currently call for any modification in malaria eradication strategy, **but the danger signs should not be ignored**. A plan for more widespread testing of susceptibility levels of this and other vectors is being implemented with high priority.

11. **The Team heartily supports the Center's recent decision to abondon the system of routine house-searches for anophelines in a limited number of villages in each malaria Unit area**. The procedures now being discarded provided no yard-stick for measuring level of anopheline populations nor the adequacy of spraying operations in the villages not sampled, and may actually have accounted for the complacency of some Unit officers with reference to the general situation in their areas.

12. With the initiation of the surveillance program, house searches for anophelines by well trained entomology technicians can aid the Unit malaria officer in his investigations of parasite positive cases. However, failure to find anophelines in localities investigated sometime after transmission may have taken place do not constitute proof that the case could not have been autochthonous.

13. Among reasons given by householders for refusal of house spraying, the Team has noted the bedbug nuisance as one of the most serious. **The studies confirming resistance of bedbugs to insecticides in some areas should be extended to all Units reporting this problem. The more precise definition of this "refusal" problem might best be made by special teams including health educators as well as entomologists, to determine whether a much-needed program of remedial action should emphasize persuasion or special insecticidal measures, or both.**

14. Nomadism and movements of people within the country, along or across the border and the so-called "difficult areas" pose a potentially serious threat to the orderly achievement of malaria eradication and demand the institution of special measures to meet this threat.

15. **The Team is convinced that the future of malaria eradication in India is dependent almost entirely on the ability of the individual spraymen and the individual surveillance workers to carry out his duties in an acceptable manner and to his supervisors to provide the leadership and directions of eradication activities.** If the 1961-62 spraying operations and epidemiological investigations are properly executed the Team believes that the following year (April 1, 1962) there can be Unit areas in India from which spraying may be withdrawn. This would permit increased attention to the remaining Units.

16. The economic implications of this tremendous undertaking lead one to the conclusion that during a six year period from April 1, 1957 to March 31, 1963, (preparatory, attack and consolidation), a per capita investment of a little over Rs. 2.01 (or U. S. $0.44) will probably have reduced malaria to a focal disease which permits its walling off into well-defined pockets for the terminal attack.

17. Substantial quantities of insecticide will be carried over at the end of the current spraying season and shipments now pending from the United States would appear to be quite adequate for the next spraying season. **As withdrawal of spraying in substantial number of units may occur in calendar year 1962, attention needs to be directed to the special problems of logistics of insecticide storage and delivery.**

18. The present fleet of vehicles, plus scheduled additions, should be fully adequate to meet the transport needs of the program. **Improvements in**

vehicle care and maintenance and utilization are needed to minimize operational problems.

19. The Team is apprehensive concerning the diffuse responsibility which may result from the autonomy enjoyed by various official and other organizations which carry on their own malaria eradication activities (railroads, coal fields, tea estates, Defence establishment, public works departments and some urban corporations). Although most of these groups have had long experience in anti-malaria work, **the national responsibility of the NMEP might be more firmly exercised if operational and epidemiological reports were received on a monthly rather than on annual basis. It is further recommended that there be an exchange of monthly reports between any NMEP Units and any other groups operating within the geographic limits of such Units, thus facilitating a review to insure total coverage.**

20. The planning and execution of a Malaria Eradication Program ideally require a unified command and a near-military precision in the operations, admittedly difficult to achieve in a federation of States. **The Team believes that a mechanism to provide a more frequent exchange of views, plus discussion of problems and their alternative solutions, will maintain the advantages of national unity of purpose and the adjustments necessary because of inherent differences in the States' administrative and technical conditions.** This need might be satisfied by periodic meetings of key personnel from the Center with all Deputy Directors of Health (Malaria) from the individual States.

21. The Team is pleased to record its conviction that there is abundant evidence of dynamic leadership at the Center and that NMEP's management of the program is fully appreciated and supported by the Ministry of Health, by the National Planning Commission and by the Ministries of Health of most of the individual States.

22. It is gratifying to know that Ministry of Health of the Government of India and especially the office of the Directorate General of Health Services are not only fully aware and alive to all the problems facing the program but are taking the deepest interest of every phase of the activities and are making every effort to surmount the difficulties as expeditiously as possible. The team also realizes with a great deal of satisfaction that all sections of the Government of India are extremely aware that malaria eradication is in progress and are giving their fullest support.

INTRODUCTION

The Government of India and TCM undertook cooperation in a National Malaria Control program in 1953. In 1956, by mutual agreement, it was determined that an international team of three Malariologist Consultants would serve for a total period of three months on an evaluation of the National Malaria Control Program of India. The team, composed of Professor John M. Henderson Savannah, Georgia; Dr. Martin D. Young, Columbia, South Carolina and Dr. L. J. Bruce-Chwatt*, Lagos, Nigeria, arrived in India during January, 1957 and spent a period of about 11 weeks. Their report was of great value to the Government of India and to TCM in evaluating the progress of the Control Program and no doubt influenced its conversion to an Eradication Program.

The Government of India and TCM have enjoyed splendid cooperative relations during their association in the Eradication Program and early in 1960 mutually agreed that a team of three Consultants from outside of India should spend two to three months during the current spraying season evaluating the current status of the NMEP of India.

On September 6, 1960, the team assembled in Washington, D. C. in the Office of Public Health of the International Cooperation Administration for two days of conferences. It left Washington September 7th, stopping for one and a half days with the Malaria Eradication officials of the headquarters of the World Heath Organization in Geneva, and arrived in New Delhi early on September 11th for a nine weeks program. The members terminated their mission in India on November 12, 1960.

The team included Dr. Donald Pletsch, Senior Malaria Advisor of the Pan American Health Organization (WHO) in Mexico; Dr. F. E. Gartrell, Assistant Director of Health, Tennessee Valley Authority, Chattanooga, Tennessee and Dr. E. Harold Hinman, Chief, Technical Resources Division,

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* The generous cooperation of the Rockefeller Foundation made possible the visit of Dr. Bruce-Chwatt.

Office of Public Health, International Cooperation Administration, Washington, D. C.

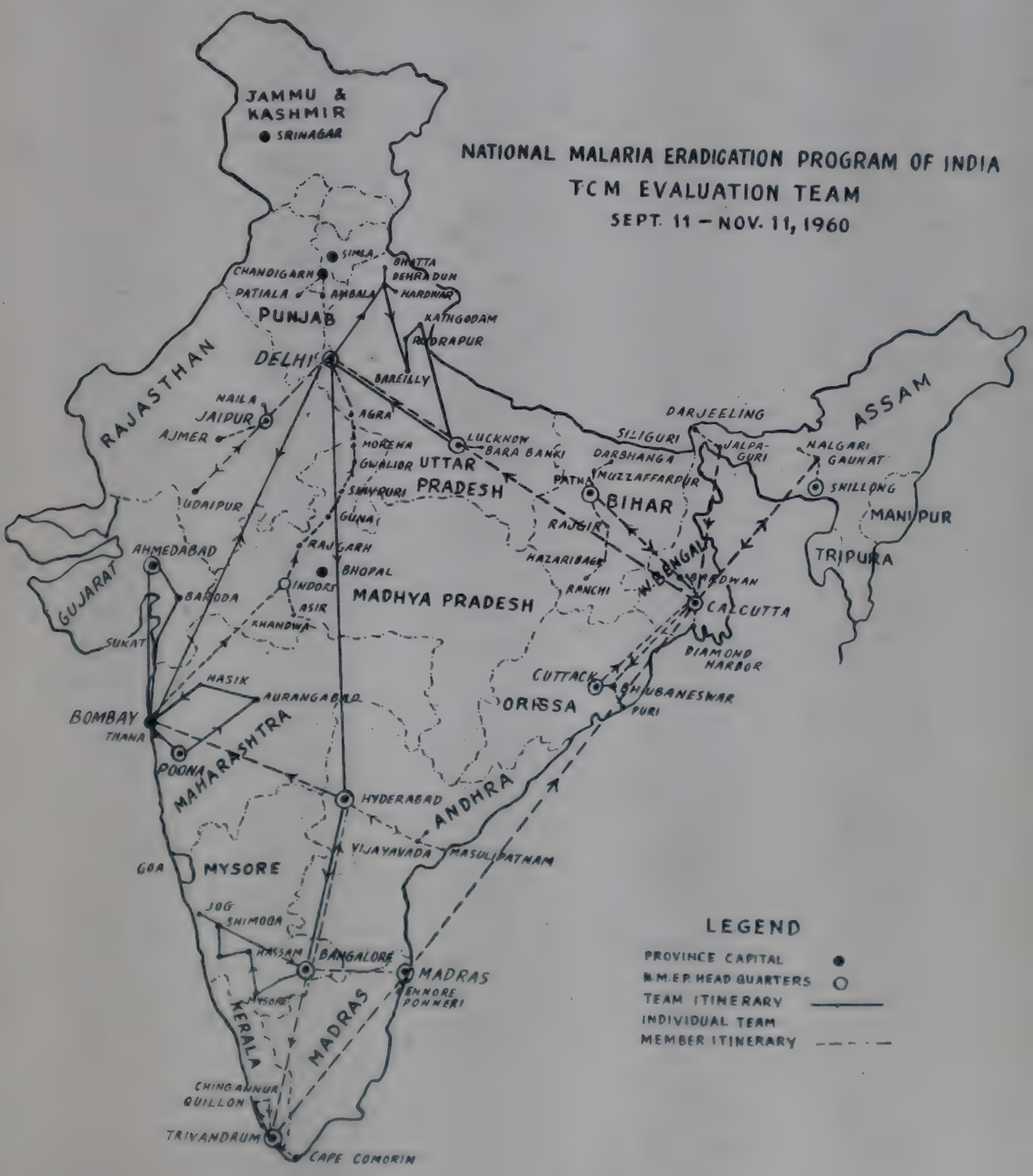
The accompanying report is intended to convey the team's own observations and impressions of the current progress that India has made toward achievement of the goal of total eradication of malaria. It is probably inevitable that we should be impressed by what remains to be done as well as the tremendous strides already made

The initiation of a program of such stupendous magnitude as the complete eradication of the world's greatest health problem by a country with the economic diffiiculties found in India reveals a courage that is admirable and a full realization that India cannot afford to let malaria remain rampant or to attempt its **control** over an indefinite period of time. It was a logical decision that a large capital investment (of money and effort) be made over a restricted number of years rather than prepetuating smaller annual expenditures to prevent the continuing toll of illness and death exacted by this dread scourge.

The team believes that Indian malariologists recognize the gravity of the task of eradicating malaria, that they are cognizant that the program demands a dedication unsurpassed in previous health undertakings; that problems both in magnitude and of types not envisioned at the outset have arisen, that more such problems will arise. However the country is committed to the eradication of malaria and there can be no turning back. A tremendous effort is required to meet this goal. The Team's concurrence in these views has been repeatedly attested to by the frankest discussions with health officials as well as with the malaria staff of the Center and the States. The following pages have been written with complete candor since they are intended primarily for scientists and for administrative officials supporting the program.

After a brief period of orientation in Delhi at TCM headquarters and at the National Malaria Eradication Program (NMEP) center, the team proceeded to assess in the field the current status of the various State programs. Thirteen state eradication programs were observed, with each visit lasting from two to six days. All team members participated in visits to Uttar Pradesh, Maharashtra, Gujerat, Mysore and the Corporation of Delhi. Thereafter, individual members separately visited Andhra Pradesh, Assam, Bihar, Kerala, Madhya Pradesh, Madras, Orissa, Punjab, Rajasthan and West Bengal. In each instance the Regional Malaria Officer and the State Malariologist accompanied the team member(s) into the field. Frequently the State Director of Health Services also

participated in the field trips. Usually conferences were arranged with the Minster, his Deputy and/or Secretary of Health of the State. During the past eight weeks each of us has visited a hundred or more villages to observe spraying or surveillance activities in hundreds of houses, many in rather remote areas. In a few States where the visit did not coincide with spraying operations, inspections were made of previously sprayed houses.



BASIC WEAPONS OF MALARIA ERADICATION

Described in its simplest form, the strategy of malaria eradication involves two major operations;

(a) **spraying operations** (the intra-domiciliary application of residual insecticides) to interrupt transmission during the period necessary for the elimination of parasitemia in previously-infected persons by natural or therapeutic means, and

(b) **epidemiological evaluation activities** (basically consisting of case-finding and case investigations)—to confirm the effectiveness of the spraying operations or to pin-point those areas where they require intensification (or use of supplementary measures) in order to terminate transmission. Important supporting roles are played by administrative services, adequate supplies of insecticides and equipment, transport, information and publicity services, entomological studies, and chemotherapeutic materials.

A "preparatory phase" of one year is commonly required for definition of the malarious area, geographic reconnaissance, training of personnel, arranging for necessary supplies and equipment, and for orientation of the public concerning the program's objectives. India substituted its 1953-58 control operations for this phase.

The preparatory year is followed by an "attack phase" of 3 or 4 years during which spraying operations are carried out thoroughly in all parts of the malarious area. Epidemiological evaluation ("surveillance") activities, which should ideally be initiated during the second year of the spraying operations, must be operating in perfected form during the final year of the attack phase. The period during which surveillance should confirm the continued absence of autochthonous cases is designated the "consolidation phase", and should cover three years (of which the first can overlap the last year of the attack phase *if* the evaluation mechanism has been fully operative). Upon the absence of autochthonous cases during three years of the consolidation phase, malaria may be declared eradicated and the "maintenance phase" may be carried out indefinitely by the normal epidemiological detection and reporting divisions of the established State health services. However until there are adequate health services provided in each unit, this will not be possible.

SPRAYING OPERATIONS

General.

Assuming that the malarious areas have been adequately defined, the maximum effectiveness of residual insecticides can only be exploited through the treatment of all existing premises of those malarious areas by the conscientious, uniform application of insecticides to the surfaces requiring spray of **all** of the houses, and associated structures to be treated. Assurance of this demanding coverage is obtained in many eradication programs through the numbering of all existing human dwellings and the spotting of such human abodes on a map of each locality which serves the field worker as a guide to ensure reaching each house, and as a check list for supervisory personnel to ensure that each house has been sprayed.

As observed by the team, the various State services operating under the NMEP have apparently felt that the refinements of map preparation and house numbering were not necessary in India due to the highly concentrated housing pattern in discrete villages. The dispersion of houses in hilly areas, and even in many plain areas where villages may consist of a nucleus of houses with many satellite hamlets, invites some doubt as to whether every house has actually been known and sprayed during successive rounds. There has been obvious difficulty in the plains villages in spraying the original quota of 80 houses per pump per day. In more difficult areas, malaria unit personnel have had even greater difficulty in attaining their quota, despite 50 per cent or 100 per cent reinforcement of the number of field workers. In extremely difficult terrain characterized by isolated houses in hilly and forested tracts, the areas assigned to some units have admittedly **never** been covered completely or the coverage has been very irregular from one spraying round to another. The units operating under such conditions which have been unable to attain their objective in 1950 despite conscientious efforts, are now well known to the State Malaria Officers and special provisions in personnel and equipment must be made immediately in order to have the State and National activities qualify as part of the Malaria Eradication program. In such extremely difficult areas it is inadvisable to further increase the number of field workers without a proportionate increase in senior supervisory staff. A more logical resolution of the problem is the re-definition of units, reducing each area to be covered to a point where a normal complement of field and supervisory staff can ensure total coverage. Extension of the spraying season may accomplish the same objectives.

Spraying equipment and techniques

Within the staffing pattern of the standard Malaria Unit (See Appendix A), the element of spraying operations in the Indian program is the squad or gang consisting of five field workers under the direct supervision of a superior field worker. When stirrup pumps are used, these are assigned at the rate of two per squad. Each of the two spraymen has an individual "pumper". The fifth field worker carries water, mixes insecticides and otherwise assists the two stirrup pump teams. When hand compression sprayers are used, these are assigned at the rate of 3 per squad of five field workers. Stirrup pumps are obviously preferred by spraymen; the stirrup pump and bucket of insecticides are carried by the pumper, and the spraymen handle the hose and spray lance. Spraying pressure when using the stirrup pump is determined by the speed at which the pumper operates the plunger, and many of the pump operators have obviously become very skillful at this type of work. Great variations in spraying pressures are common among workers of the same unit, and even in the same squad with resultant irregularities in the pattern and quantity of insecticidal deposits.

Many spraymen employ the spray lance in an orderly manner, depositing the insecticides uniformly on the walls and ceilings, but a larger number of spraymen swing the lance in a very irregular pattern, at excessive speed, constituting what we have termed the "orchestra-conductor baton" technique. This method requires multiple passage over the surfaces requiring spray in order to obtain an adequate deposit, but regular superimposition of successive swaths is rarely achieved.

Hand compression sprayers, equipped with automatic pressure regulators, are favored only in difficult areas where it is impractical to carry on open bucket of DDT suspension for the spraying of isolated houses. Most of the hand compression sprayers have a 4 gallon capacity, obviously too heavy for the local workmen; 3 gallon sprayers are clearly indicated for such work in irregular terrain.

The insecticide suspension is prepared through volumetric measurement of the 50% or 75% water wettable DDT powder. Volumetric measurement has been found in other programs to result in considerable extremes in concentration of suspension. Gravimetric measurement is usually recommended. In a few instances it has been observed that the cup used locally for such measurements is bent or broken and the workman preparing the suspension obviously has no sound basis for measuring the material.

Erosion of nozzle tips is taken into account through weekly measurements of discharge rate. The maximum discharge permitted is 32 ounces per minute. A number of malaria inspectors, who are responsible for the measurements of nozzle tip discharges, have shown inconsistency in their knowledge of the correct periodicity at which measurements should be made and concerning the permissible limits of discharge. Only a few inspectors are recording the successive discharge of individual nozzle tips.

The spraymen (field workers) do not carry the flashlights obviously needed in some areas for the systematic spraying of walls and ceilings in dark storerooms and other unlighted parts of the premises. Senior field workers (squad leaders) and even senior malaria inspectors are frequently attempting to supervise spraying operations without flashlights.

In summary, various aspects of the spraying operations lack the refinements desired in a malaria eradication program and reflect a lack of the engineering personnel who are particularly effective in achieving precision in large scale operations in other countries. The spraying techniques now being employed will doubtless prove adequate in many areas with low anopheline populations; in areas where surveillance procedures reveal continued transmission it will be difficult to exclude inadequate spraying operations as the cause of the failures. Qualitative and quantitative intensification of field supervision at all levels is essential to improve the quality of spraying operations.

Locked houses and "refusals" as affecting total coverage

A considerable number of unsprayed houses in many villages result from locked premises encountered by the spraying squads. In most instances the houses are legitimately locked because the householders are absent from the area for a variety of reasons. In villages where spraying is not desired for one reason or another, the householders may lock their houses and absent themselves merely to avoid the annoyance of the spraying. The units in some States have organized "mopping-up squads" to re-visit the villages and spray the originally locked houses. This is a costly, tedious and only partially successful measure. Householders are refusing to have all or parts of their houses sprayed for a variety of reasons, principal of which are religious beliefs, conviction that spraying increases the bedbug nuisance (see "Bedbug resistance" on page 20), silkworm mortality and mortality among cats and other domestic animals. These fears are sometimes well-founded and the impression is gained that field personnel are often accepting them as an excuse for not spraying the houses. In a number of instances the members of the team inquired regarding the reasons for not spraying certain houses or parts

of houses; when the householder was questioned, and reasonable arguments were presented, permission was obtained. It is probable that any public information program which would better orient the householders concerning the objectives of the campaign would substantially lower the number of refusals. Where refusal rates are low it has often been evident that senior supervisory personnel of the unit have been effectively intervening at the village level to immediately orient and convince village leaders and individual householders.

Lime-washing and mud-washing of walls

In many parts of India, the plaster walls of houses in towns and the mud walls of rural houses are "lime-washed" or "mud-washed" with a very thin slurry of mud or cow-dung one or more times per year for religious or aesthetic reasons. Hindu families of sufficient means conventionally follow this practice in observing the Diwali festival in late autumn. In some communities the mud-washing is carried out on the undersides of roofs as well as on the walls of houses and cowsheds. In limited rural areas the more meticulous housewives may mud-wash their houses each week, or whenever the walls become soiled. Spotting with DDT suspension during spraying operations provokes the cleaning urge in such households.

Investigations carried out on the extent to which mud-washing destroys the effectiveness of deposits (most recently by the NMEP Regional Coordination Office, Cuttack) show that the very thin slurry sharply decreases, or possibly completely eliminates the insecticidal action.

Although the team recognizes that basic cultural patterns do not yield readily to pressure, with or without reason, more intensive local information programs should be carried on continually to convince the housewife that DDT spots are not "dirt" but are actually health-saving deposits to protect her family and herself.

The Diwali associated mud-washing custom is less susceptible to rational change; fortunately it occurs after the transmission season in most areas, and normally does not include treatment of the ceilings (under-roof surfaces).

In addition to the mud-washing and lime-washing practices which neutralize the deposits on sprayed walls it is recognized that construction of new houses and the re-thatching of old houses may also result in incomplete protection of families or communities. The most serious danger from non-treatment of newly constructed houses exists in the labor camps associated with hydroelectric and

highway projects. Special vigilance must be maintained in such areas, and periodic rounds by special spraying personnel must be carried out to ensure adequate protection. No ready solution is apparent for re-spraying of roofs or walls being re-thatched in rural areas on an irregular basis.

Newly recruited spraymen must receive minimal training from a malaria inspector. At the beginning of each season even experienced spraymen require a refresher training. They must be completely familiar with spraying equipment including re-placement of worn parts. They need indoctrination concerning the structures and surfaces to be sprayed. They must be masters of the technique of spraying so that the insecticide is applied uniformly and complete coverage is obtained. They must learn how to secure and maintain good public relations. Squad leaders or superior field workers, in addition to the above points, must possess a good basic concept of malaria eradication and the role of the anopheline in transmission with special emphasis on mosquito habits including indoor resting preferences. They must know how to properly prepare insecticidal mixtures and to maintain the register or diary covering squad accomplishment.

EPIDEMIOLOGICAL EVALUATION

Conventional Malariolometric Indices

As a nation India has accumulated a vast amount of data concerning the occurrence of malaria within the past five decades. With the initiation in 1953 of the malaria control program on a national basis three conventional indices (spleen rate, child parasite rate and infant parasite rate) were adopted and a routine developed for their implementation. The NMEP Program in 1958 continued these techniques. The activities of the control program and initiation of the eradication campaign dramatically reduced malaria to such a low level that these three indices have now become practically useless. The accompanying table provides a general summary of results on a country-wide basis for recent years. The NMEP procedure has been to require each standard unit to make spleen surveys on 20,000 children 2 to 10 years of age from selected villages, to take 10,000 blood films from the same group (actually taking the slides from alternate children in the spleen survey) and to obtain 1,000 blood films from infants under 1 year of age from the same areas.

An analysis of Table I reveals that since 1958, spleen rates have been very low, child parasite surveys have revealed few cases and infant parasite surveys shown practically no positive slides. It would appear that a "meter stick" is utilized to measue something "microns" in length.

It is recognized that in an individual village a spleen rate may be of significance but the data from such a village may be obscured in the consolidated report from the entire unit. They would be further obscured in the preparation of State or National figures. As an example of this in Maharashtra State the 1959-60 survey revealed a total of 101 villages having spleen rates of more than 10 per cent. Half of these villages occurred in one unit and over forty per cent of them were located in a single Taluka. In many instances the samples were small. Such a large number of villages where spleen rates were of significance is quite unusual and the usefulness of spleen surveys is highly questionable except in these few localities where initiation of spraying was delayed or other factors prevented total coverage.

The blood film examinations in the past two years have revealed an exceedingly low positivity and the examination of 11,000 blood films from infants

TABLE I

SELECTED MALARIOMETRIC DATA (BY STATES)

STATE	1956 – 1957			1957 — 1958			1958 — 1959			1959 — 1960				
	Spleen Rate % +ive	Child Parasite Rate %	Infant Parasite Rate %	Spleen Rate % +ive	Child Parasite Rate %	Infant Parasite Rate %	Spleen Rate % +ive	Child Parasite Rate % +ive	Infant Parasite Rate	Spleen Rate % +ive	Child Parasite Rate %	Infant Parasite Rate %	Parasite Rate from dispensary No. examined	Malaria cases (clinically diagnosed) +ive
Andhra Pr.	12.7	3.7	1.8	9.8	6.3	2.2	8.2	7.9	1.6	2.1	0.1	0.4	2810	75
Assam	19.9	4.1	7.4	19.3	8.2	19.1	24.2	4.3	4.2	8.0	2.3	1.0	128	25
Bihar	11.2	0.8	0.3	7.2	0.9	0.3	2.9	0.1	0.1	1.2	0.05	0.0	2346	7
Bombay	2.3	0.1	1.0	2.3	0.3	1.4	1.4	0.5	0.4	0.6	0.05	0.02	5816	185
Gujarat										0.2	0.0	0.0	2352	23
Maharashtra										0.8	0.1	0.02	3464	162
Delhi	0.4	0.0	0.02	0.2	0.02	0.0	0.3	0.2	0.0	0.1	0.02	0.0	1160	30
Him. Pra.	1.1	1.4	7.3	1.6	0.0	0.3	0.6	0.0	0.0	0.2	0.0	0.0	906	nil
Jammu & K.	3.4	0.0	0.0	2.1	0.4	0.0	0.6	0.0	0.0	1.5	0.0	0.0	88	nil
Kerala	4.6	0.4	0.0	1.7	0.2	0.0	0.9	0.0	0.0	0.2	0.0	0.0	104	1
Madhya Pr.	8.7	1.0	1.4	6.4	0.9	0.9	5.5	1.4	0.4	3.5	0.3	0.7	4940	64
Madras	7 3	1.1	0.02	4.4	1.1	0.05	1.9	0.4	0.0	0.2	0.02	0.0	4764	50
Manipur	10.1	0.02	0.03	10.2	0.03	0.03	4.8	0.0	0.0	1.7	0.01	0.02	331	7
Mysore	1.4	0.2	0.08	1.3	0.3	0.5	0.5	0.2	0.1	0.4	0.07	0.03	11522	405
Naga hill										N.D	N.D	N.D	N.D	N.D
Orissa	N.D	N.D	N.D	9.9	2.7	2.2	13.1	1.3	0.6	8.0	1.6	0.9	511	nil
Punjab	1.4	N.D	0.07	1.4	0.8	0.02	1.1	0.04	0.0	0.5	0.2	0.0	818	9
Rajasthan	12.1	3.3	0.0	7.6	0.2	19.9	5.6	2.7	2.2	2.8	0.2	0.01	10513	46
Tripura	3.9	3.1	0.0	0.2	0.2	0.4	4.9	1.1	3.3	2.5	0.0	0.2	190	6
Uttar Pr.	11.1	2.3	1.3	7.4	0.6	0.3	4.4	0.4	0.3	1.3	0.1	0.09	3664	267
W. Bengal	4.0	0.2	0.9	2.3	0.2	0.7	1.2	0.0	0.0	0.4	0.06	0.0	834	nil
NEFA				40.7	N.D	N.D	19.5	8.7	1.9	9.5	5.6	2.4	2078	542
Sikkim				27.5	N.D	N.D	N.D	N.D	N.D	5.7	N.D	N.D	N.D	N.D
Coalfield	1.1	0.3	1.7	0.7	0.2	0.1	0.8	0.2	0.3	0.6	0.02	0.0	9190	98
Andamans														
TOTAL	6.0	1.1	0.5	4.2	0.8	0.6	3.2	0.5	0.2	1.4	0.16	0.14	62713	2002

and children from each of nearly 400 units in India burdens about 800 technicians with almost certain negative results. The time of the Unit Malaria Officer concerned in this profitless activity will most certainly detract from the potentially more profitable surveillance activities. Reconsideration of the entire plans for these mass surveys is essential. Otherwise the urgent work of active surveillance will be delayed.* Unfortunately many unit officers are still planning these.

It came as a shock to the Team that in certain instances spleen surveys were performed by senior malaria inspectors and by other non-medical personnel. Elsewhere in this report the statement has been made that spleen surveys are now practically useless. Those done by non-medical personnel are considered worthless.

Passive Surveillance

In its classification of surveillance, the Sixth Report of the WHO Expert Committee on Malaria stated, "Passive search consists of the notification of all suspected malaria cases and the submission of blood films from fever cases by doctors or laboratories taking the films, together with subsequent verification of the cases." It is evident that an arrangement for obtaining blood films from suspected malaria cases or fever cases in dispensaries can serve two purposes. Whether or not there are significant amounts of malaria in the general population, the dispensary-obtained slides represent a relatively fruitful source of positives. If there is **no** malaria, the attempted parasitological confirmation of clinically diagnosed cases will discourage the use of malaria as a catch-all for fevers of undermined origin. Passive surveillance is designed to obtain blood films from all individuals having fever and who report to any dispensary, hospital, or call upon the services of a medical practitioner. The last is difficult to achieve, and in most malarious countries we must be content to obtain blood films from patients attending any dispensary or outpatient (outdoor) services of any hospital who admit having fever. Also the importance of inpatients must not be overlooked. It is fully recognized that in remote areas, as well as elsewhere, a large number of sick people do not attend dispensaries, hospitals or ever see a physician.

According to the 1958-59 annual report of the NMEP the dispensary statistics revealed that of 47,402,754 cases, there were 4 per cent or 1,915,975 clinically diagnosed as malaria. The "Statistical Appendices," published by the

*Although the Center is planning to restrict these the Team found numerous unit officers ready to continue them in a routine manner.

Directorate of Medical and Health Services of the Government of Rajasthan, Jaipur for the year 1959-60 revealed a daily average of 102,368 rural and urban "outdoor" (outpatient) patients for an annual total of 9,419,660. This indicates that the equivalent of more than one half of the entire population of the State attended the outdoor service of a dispensary or hospital once during the year. Of these, 595,096 or 6.3 per cent were treated as malaria. Obviously very few of these were actually malaria cases and a negligible number of slides had been forwarded to State NMEP headquarters (See Table I). Of the small number received, a significant percentage was positive. The physicians, from habit, are continuing to diagnose cases with fever and vague symptoms as malaria.

In several States visited by the Team it was learned that directives have been sent to the dispensaries by the Directors of Health and/or Medical Services requesting the submission of a blood film from each case of clinically diagnosed malaria. In no instance have significant numbers of slides been received. Since there has been such a marked delay in the initiation of active surveillance across the nation (see page 14) it is suggested that immediate effort be directed to exploiting the various dispensaries and outdoor services of all the Government hospitals. Without seriously impeding the progress of active surveillance it would be possible to utilize the part time services of some malaria surveillance inspectors, or other personnel of the malaria unit (particularly during the non-spraying season) to go at intervals to the hospitals, dispensaries, etc. within the unit, to train compounders or other auxiliary personnel in the proper taking of blood films and to arrange for the collection of slides at regular intervals in the remote areas. Actually a few hours of time of NMEP personnel regulary devoted to this activity or even to the taking of films until such time as a satisfactory procedure can be organized for the dispensaries and hospitals to submit promptly blood smears from **all** of their fever cases, will give extremely useful information now that the conventional malariometric indices have reached such a low level. During the next twelve months India could utilize its dispensaries and its outdoor services of hospitals as a huge filter screen out fever cases as a rich source of parasite-positive individuals, a method effectively complementing active surveillance which is going through so many "convulsions" in its organization.* It is not visualized that any additional personnel will be needed except possibly in certain malaria unit laboratories. This will be referred to elsewhere.

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* Subsequently it was ascertained that on November 10 the Center directed immediate initiation of passive surveillance.

The potential richness of this technique is noted from the following recent experience in Madras State :

> A total of 272,233 child parasite survey slides revealed 32 positives (0.012%). Active surveillance recently initiated provided 91,724 slides of which 163 (0.16%) were positive. In contrast only 7073 slides from dispensaries revealed 144 positives (2.03%).

Active Surveillance

When malaria is reduced to a very low level it becomes extremely important to locate and promptly treat the individual case, to make a through epidemiological investigation concerning the origin of the case, and to determine if secondary transmission has occurred, and to take appropriate action. In December 1959 the Indian Workers Conference determined that active surveillance would begin as of April 1, 1960. However due to inability to obtain immediate sanctions in many States there are few areas that now approach 75 per cent coverage. Several have no surveillance workers in the field. This means that there is no accurate information concerning the occurrence of malaria during the 1960 season. Such data would have been of tremendous help for the planning of the 1961 spraying schedules. Now it is almost certain that many areas which could otherwise have been considered for withdrawal of spraying will have to receive coverage in 1961. India has launched an ambitious program of surveillance which is planned to question every family in the entire nation once fortnightly as to whether *any* member of the household has, or has had, fever during the previous two weeks. An affirmative reply results in the taking of a blood film and on-the-spot administration of a suppressive dose of an anti-malaria drug. If the laboratory reports the presence of malaria parasites the patient will be administered a five day course of radical treatment (primaquine) and a through epidemiological investigation made. Each unit of a million population is being provided with a group of 100 surveillance workers and 25 surveillance inspectors. Each malaria surveillance worker is expected to visit 200 dwellings per day for each of ten working days in the fortnight or to be responsible, on the average, for investigating 10,000 persons within the period. Thus across the nation on each working day householders are to be questioned concerning the occurrence of fever in 40,000,000 people. Nearly fifty thousand serveillance workers and inspectors will be involved. In the densely populated areas this requires an even larger work load per investigator with a correspondingly lighter load in scattered areas.

It is too early to assess the feasibility and adequacy of the program of active surveillance. The thoroughness of the house visitation is more important

than the semi-monthly coverage. The delays and excuses for not yet achieving total coverage have been appalling. Supervision must be tightened up and a few suggestions concerning reporting are given below.

It is urgent that every senior malaria inspector (in charge of each subunit), each unit malaria officer and his assistant unit officer, each zonal officer and each State malariologist have a monthly report sheet showing the activities of each surveillance worker. A suggested proforma (A) is attached which would accommodate the reports of 25 or more surveillance workers. The data from the various subunits can then be summarized at malaria unit headquarters on sugges-ed proforma (B). This form would then be utilized to summarise surveillance and laboratory performance for each State. Thus the Center (NMEP) and Regional Officer could find a concise summary of surveillance (both active and passive) on a single sheet which should be available within a week after the first of the month. It is suggested that the Unit Officer maintain a master wall chart for a year's period covering the performance of his 100 surveillance workers for each fortnight. It should be noted that utilizing the "number of slides obtained from fever cases per thousand population" equalizes the expected production of surveillance workers in scattered rural areas where possibly only four or five thousand population can be assigned to a sector as compared to larger urban areas where a single surveillance worker may have responsibility for a sector with fifteen or more thousand population to be served fortnightly.

The initiation of surveillance was just in progress at the time of the visits to most States. There is still no basis for accurate prediction of the number of slides to be obtained throughout the year from a unit of one million population. The thoroughness of the inquiry at each household, the confidence which the surveillance worker may inspire in the public, the occurrence of seasonal epidemics (respiratory and other), etc. will determine this. However, experience in other countries would suggest that between 50 and 100 slides per year might be expected from each 1000 population. With fortnightly coverage some 3 to 4 slides per round per thousand population might be expected. Therefore 100 surveillance workers would probably accumulate 200 to 400 slides per working day. This exceeds the capacity of two laboratory technicians. It should be anticipated that the equivalent of at least four technicians will be needed per unit, one extra immediately. Certain of these additional technicians should be placed in state laboratories. If passive surveillance is successful this will further strain the resources of the unit laboratory. This estimate also assumes that the child parasite village survey and the infant parasite surveys will **not** be continued on a mass basis.

PERFORMA A

MONTHLY REPORT OF ACTIVE SURVEILLANCE BY SUBUNIT

_____Subunit_____Unit_____STATE

Month_____Year 196 .

No. & code No: of Surveill-ance worker	Sector	Assigned popula-tion	FIRST FORTNIGHT			SECOND FORTNIGH		
			No. of Cases fever	No. of Slides taken	Slides* per 1000 assigned popula-tion	No. of Cases fever	No. of Slides taken	Slides per 1000 assigned population

*utilize nearest number of thousand of population. e.g.,

12 fever cases in assigned population of 8000 $= \frac{12}{8} = 1.5$

N.B.—Unit Officer will prepare a cumulative wallchart summarizing activity of entire unit for one year.

PROFORMA B

SURVEILLANCE SUMMARY (ACTIVE & PASSIVE) FOR STATE OF _____ MONTH OF _____, 196 .

Unit Name	Population of unit	1st Fortnight			2nd Fortnight			Total Dispensary cases diagnosed clinically as Malaria			Laboratory activties (exclusive of routine assessment)				
		No. of S.W. at work	No. of fever cases found	No. of slides taken	No. of S.W. at work	No. of fever cases found	No of slides taken	No. of cases	No. of slides	No. +ive	Total slides recd.	No. examined	Number positive	Balance not examined	No. of slides on hand at First of Month
Total															

ENTOMOLOGICAL ASPECTS OF THE MALARIA ERADICATION PROGRAM

GENERAL CONSIDERATIONS

Those locally responsible for the entomological aspects of the national malaria eradication program have benefited greatly from India's historic leadership in research concerning the role of anopheline mosquitoes in the transmission of malaria. The Program has been aided by the magnificant fund of entomological information on the distribution, vectorial capacity, biology, and reaction to insecticides of the 44 species of **Anopheles** mosquitoes present in India.

The six species considered as vectors of primary importance are **Anopheles culicifacies, A. fluviatilis, A. minimus, A. philippinensis, A. stephensi**, and **A. sundaicus**. Of much lesser importance, and of limited distribution, are **A. annularis, A. jeyoriensis** var. **candidiensis, A. leucosphyrus,** and **A. varuna**. Three additional species (**A. aconitus, A. maculatus,** and **A. subpictus** var. **subpictus)** deserve mention because they are known as vectors in other parts of the world, although never incriminated in India.

Anopheline Resistance to Insecticides

One of the most compelling arguments for the immediate accomplishment of malaria eradication in India and globally is the evidence that loss of susceptibility to residual insecticides is occurring in various species of malaria-transmitting mosquitoes. Anopheline resistance to insecticides in limited portions of a country does not mean that malaria eradication will become impossible. However, widespread development of this phenomenon will greatly change and complicate the technique to be employed, with vastly increased costs.

Of the six vector species in India as listed above, susceptibility testing has been carried out on three species (**A. culicifacies, A. fluviatilis, A. stephensi)** originally using the Busvine-Nash test, and more recently using the procedures and equipment standardized by the World Health Organization. Testing has also been carried out on **A. annularis, A. subpictus** var. **subpictus,** and **A. splendidus**. The majority of the tests have been executed by entomologists of the Malaria Institute of India, of the NMEP headquarters, of the NMEP regions, and by entomologists in a very few of the States. Many of the States have

received one or two WHO testing kits rather recently; several have reported that they have made no tests "because it is impossible to find enough anophelines to carry out the tests."

In order to determine general 1960 susceptibility levels of **A. culicifacies**, in widely—scattered areas, Maharashtra State has tested adults from 60 locallities by exposures for one hour to standard papers with a single DDT concentration 2%. In 15 of the 60 villages less than 60% mortality has been noted and special attention has been focussed on these 15 localities.

Considering the long period of time that intra-domiciliary application of residual insecticide has been carried out in some parts of India (since 1947), the results of testing to date have been predominantly favorable. **Anopheles fluviatilis,** tested in 1959, showed no resistance to DDT. In 1958, **A. stephensi** larvae from Madras were found to be resistant to DDT but susceptible to dieldrin. There is no evidence that this species, predominantly breeding in wells, is transmitting malaria in those parts of India where it is nonsusceptible. Of the anophelines less dreaded as vectors, **A annularis** was found susceptible in 1956 to both DDT and dieldrin in Rajasthan. **Anopheles subpictus subpictus** from several States has shown resistance to DDT and or dieldrin, but this species apparently plays no role in malaria transmission.

The most serious anopheline resistance threat is that represented by the **A. culicifacies** situation in mid-western India, especially in the Panch Mahal area of Gujerat State. According to findings of the WHO Malaria Eradication Advisory Team No. 2, the susceptibility to DDT of this important malaria vector has declined sharply since early 1960; a small percentage of the tested specimens has withstood 8 hour exposures to 4% DDT papers, and specimens have been observed resting on fresh DDT deposits. The local inclination to label this survival as "tolerance" cannot make the anophelines less resistant, nor should it obscure the urgency of prosecuting the malaria program with maximum dedication and finesse in order to complete it while present weapons can still do the job.

Routine search for Anophelines

With few exceptions, each sub-unit of each unit has selected five (or sometimes six) villages within its jurisdiction. Four to six catching stations are designated in each village, usually including two human dwellings and two cattle sheds, and at times two additional dwellings with attached cattle sheds. In total a unit covering 1,000,000 people may therefore attempt day-time searches of 30

minutes each, at weekly intervals, in 80 to 144 structures situated in 20 to 24 villages (a unit may commonly have from 1000 to 3000 villages). A limited number of "general" collections may be made in additional houses selected at random. Any anopheline mosquitoes collected are held in test tubes to determine 24-hour mortality, and man-hour densities are recorded. According to the NMEP Manual (page 76)....."During the attack phase, the assessment will ensure that the insecticide spraying is effective, by either reduction of the longevity of the vector to less than the extrinsic incubation period, or in most cases a sustained reduction in the population of indoor-resting vectors or both."...It is the opinion of the Team that the routine anopheline collections, as currently practiced in the field, do not permit the assessment mentioned above, and may actually encourage a very dangerous complacency on the part of the unit and State staff. In the units visited, the villages selected for captures were generally very close to the subunit headquarters. These villages (and generally the capture station structures) are known to the Senior and/or Junior Malaria Inspectors who are supervising spraying operations, and it would be unnatural for them to give such structures and villages a less-than-normal application of insecticides. The capture stations have not been selected on the basis of pre-spraying positivity; thus subsequent negative results may indicate effectiveness of insecticide deposits, *or* may merely mean that the house was one of those never attractive to mosquitoes. Most dangerously, absence of anophelines or low man-hour densities in the very small number of sampled villages may lead the unit personnel to assume that the same condition exists in the hundreds or even thousands of villages *not* visited. The Team contends that all unit and sub-unit supervisory staff must first ensure complete and uniform spraying practices, the effectiveness of which is best confirmed by the surveillance case-finding system, immediately and zealously executed.

Intensive efforts to house-capture anophelines are of obvious value as part of exhaustive investigations of malaria cases, but routine searches in 0.05% of the houses of a unit area have very debatable program assessment value.

Bedbug resistance

In a number of areas where intra-domiciliary application of insecticides has been carried out since 1947, the householders are definitely suffering from high populations of bedbugs, resistant to DDT and to BHC. The problem is so acute in certain areas that the residents definitely prefer the threat of now forgotten malaria to the actual distress caused by the bedbug infestations, inasmuch as they are convinced that the present bedbug difficulty stems directly from insecticidal application. This problem not only affects the areas with known bedbug resis-

tance, but is a factor in adjacent communities where the residents wish to avoid this trouble and similarly refuse spraying operations. Although bedbug resistance is sometimes used as an excuse for refusal, the unquestioned resistance is a basic problem constituting a serious threat to successful accomplishment of the malaria eradication program in some areas. Considerable research on bedbug resistance has been carried out in the State of Maharashtra where diazinone is being used in limited field areas against this pest. The gravity of the resistance problem and the fact that diazinone is highly toxic to spraying personnel emphasizes the desirability of immediate and more intensive field and laboratory investigtion to discover more practicable insecticidal measures against this pest. It is believed that the State facilities in Maharashtra and the Malaria Institute facilities in Delhi are quite adequate to launch or intensify such investigations, which are of great importance to the malaria eradication effort.

Silkworm Culture

In certain areas such as Mysore and Assam, the culture of silkworms and production of raw silk is receiving encouragement as a cottage industry. Without question the residual spraying program causes heavy mortality of silkworms when carried out in the same rooms with the young or half-grown larvae.

Investigations carried out in Mysore State have even indicated that larvae cannot be successfully reared in rooms treated some months before with residual insecticides. This is contrary to the experience in Taiwan where malaria eradication efforts have been successfully carried out in aboriginal villages where silkworms were being cultured in almost every household. In the Taiwan program, spraying of such villages could not be carried out when worms were actually present, but silkworms were successfully cultured in rooms sprayed some months even a few weeks prior to the hatching of the eggs, as long as the larvae and food plants were not brought into actual contact with the insecticide deposits.

INSECTICIDE SUPPLY

Under the National Malaria Control Program, insecticides were furnished to each unit at an annual rate of 53.3 tons (long tons) of 75% water wettable DDT This was found to be inadequate for the intensive coverage planned under the eradication program. Thus in 1958-59 when the eradication program was launchnd. the unit quota of 75 per cent DDT was increased to 71 tons for 2 rounds of spraying or 35.5 tons for 1 round. For the 1960-61 spraying season DDT requirements were estimated at 90 tons per endemic unit (2 rounds) and 45 tons per hypoendemic unit (1 round). For the current spraying season,

1960-61, insecticide requirements were estimated at 28,800 tons of DDT 75 per cent or equivalent. TCM supplied 22,182 tons of 75 per cent DDT and Government of India purchased 2,723 tons of 75 per cent DDT in U.S.A. DDT production in the two plants in India for the NMEP program was scheduled at 2,800 tons DDT technical formulated to 50 per cent water wettable powder. BHC is produced in India primarily for agricultural production, but 1,500 tons were allocated to NMEP for 1960. The Central Organization, NMEP, analyzes each batch of insecticide from the Indian plants before it is accepted. Inspection teams likewise run physical tests at dockside on DDT shipment from U.S.A. and collect samples for complete chemical tests and storage tests in the laboratory at Delhi.

Approximately six weeks transit time is required for shipments to reach Indian ports from the U.S.A. ports of entry for DDT are Bombay, Calcutta and Madras. The Assistant Director of Stores, NMEP, Delhi, in collaboration with State organizations, determines the distribution to be made of each shipment. Actual distribution is made by the Government Medical Stores Depot (Health Ministry). As far as possible, DDT is shipped directly to the using organizations.

On field visits to the NMEP units, inspections were made of DDT storage facilities and stock position records were reviewed. With only a very few exceptions storage facilities were quite satisfactory. To the extent that time permitted detailed review of stock records and inventory, they were found to be in order. In a vast majority of units, sizeable inventories of DDT were on hand, and estimates of consumption for the balance of the year pointed to substantial carry-over of insecticides for the 1961-62 spraying season.

It was not possible, during the time available, to obtain an accurate overall stock position of DDT for the total NMEP program. However, a comparison of DDT consumption figures for 1959-60 (total approximately 49,000,000 pounds 75 per cent DDT) and for the first round of 1960-61 with data on DDT carry-over from 1959-60 and DDT purchases for 1960-61 confirms the impression that the carry-over of DDT for 1961-62 spray requirements will be substantial. This carry-over is estimated to be in the order of 15,000,000 pounds of DDT 75 per cent or equivalent as compared with a carry-over of last year of approximately 5,400,000 pounds. (This latter figure does not include carry-over in six major States and five minor area operations for which reports were not available at the NMEP headquarters in Delhi.)

In reviewing DDT consumption and stock records data obtained from NMEP headquarters, from State offices and from the units themselves, many

discrepancies were encountered. Some of these were doubtless due to incomplete records in some cases and possible clerical errors in others. At the request of the TCM team through the Central and State Organizations, each of the units has submitted or is scheduled to submit a proforma giving detailed information on insecticides used and stock position at the end of each round since the eradication program was initiated. In addition similar data that could be made available readily were obtained from the States and are included in this report. (Appendix B). Data at the NMEP headquarters, Delhi, are compiled from reports received directly from the units. It appears highly desirable to subject all of these data to critical review and analysis in order to reconcile inconsistencies in the presently available data. It is recommended that this be done. It is recommended further that an actual physical inventory be made of total insecticides on hand by locations on December 1, 1960 or as soon thereafter as possible. In States where spraying may be continued after December 1, 1960, an estimate of insecticide consumption for the remainder of 1960-61 spraying season should be requested to accompany the inventory report. It is considered extremely important that the reporting units make an accurate inventory of insecticides in stock and that they not rely on their office records to determine their stock position.

This inventory record will be helpful in making allocations of insecticides for the 1961-62 spraying season. Of greater importance, however, is the need for this information in estimating future insecticide requirements. With the prospect of having a sizeable backlog of DDT on hand for the next year or so, and with the possibility that a substantial number of units may discontinue spraying after next year, attention needs to be directed at an early date to the special problems of logistics that will be involved in this phase of the program.

TRANSPORT

The National Malaria Eradication Program has a fleet of 2,282 vehicles of which 1,839 are trucks used principally for transport of materials in support of spraying operations. Trucks are used only to a limited extent for transport of spray crews. The other 443 vehicles, 1/4 ton Jeeps and Jeep Station Wagons, are used by unit, zonal and state and central staff for general transportation required in the supervision of the malaria eradication activities. One hundred and eighty-six 1/4 ton Jeeps purchased locally are being added to the fleet during the 1960-61 spraying season. The present distribution of vehicles by States is presented in Appendix D.

The existing fleet is composed of the original vehicles acquired at the

time of initiation of the National Malaria Control Program in 1953 and subsequent additions as the program was expanded and intensified. Major additions were made in 1958 when the program was changed to one of eradication.

As the field units were visited, inspections were made of vehicles and of the repair facilities operated by the malaria organization. Information concerning vehicle operating and maintenance problems was solicited from the supervisory staff and from drivers and mechanics. To the extent that time was available vehicle operating logs were examined. In addition, detailed information on vehicles was obtained from the units by means of a proforma circularized by the central and state malaria organizations as requested by the TCM team.

The conditions under which the vehicles are operated and the generally poor quality of maintenance service available in most of the unit areas have imposed severe tests on the efficiency and useful life of the vehicles. These have been offset in part by the relatively low mileage use of many of the vehicles. In general, considering the vehicles inspected as being a fair sample, the fleet is in better condition than might reasonably be expected.

The vehicle maintenance problems experienced by many of the units appear to be due to one or more of the following :

1. Lack of a plan for training and periodic check-up of drivers as to safe driving practices and care of the vehicles.
2. Irregular servicing of vehicles.
3. Failure to fill the unit position of mechanic, or filling it with an unqualified person.
4. Lack, at most units, of even minimal shop facilities and tools that would be required for general vehicle maintenance.
5. Undue delays in obtaining spare parts when needed. Delays are frequently due to the involved administrative procedures that have to be followed. However, certain parts are in extremely short supply in India and are exceedingly difficult to obtain. Among these are bearings and gear trains for the transmission and differentials of the Studebaker and Dodge Trucks, and the Dodge Power Wagons; tires for Dodge Power Wagons; and curved windshields for Jeep forward control trucks.
6. Lack of planned periodic review of the fleet and adjustment of vehicle assignments to equalize use and to utilize available maintenance facilities to best advantage.

The Central and State organizations are aware of these problems and are taking steps to develop transport organizations at the State level. Several of the State health services organizations now have transport officers, and in at least two States (Mysore and West Bengal) a start has been made to establish and equip Central shops capable of handling major overhauls of the various types of vehicles operated by the Department of Health Services including the malaria eradication organization. The development of a transport organization is more advance in West Bengal than any of the other states visited. In West Bengal the central shop is supplemented by four zonal workshops and five mobile workshops. The West Bengal Department of Health Services has a total of 500 vehicles of which 179 are assigned to the malaria eradication program. The Transport Office of UNICEF has provided assistance to West Bengal in setting up its transport organization and to many of the other States in developing plans for similar set-ups.

Insofar as the malaria eradication program is concerned, with the exception of West Bengal, it appeass doubtful that the development of transport organizations at the state level will proceed rapidly enough to be of substantial service for the 1961-62 spraying season. Thus most of the state malaria organizations will probably be faced with the same difficulties of vehicle maintenance that have been experienced during previous years. The situation should definitely improve by 1962-63. By that time reduction in vehicle requirements should be possible under scheduled retrenchments in spraying opetations and many of the health services organizations in the States should have operating transport organizations. Where the long term requirements of the health services organizations indicate the need for it, the States should be encouraged and assisted by the Central Organization NMEP to establish transport organizations as expeditiously as possible. In States where such an organization is not contemplated or possibly may be several years in developing, the malaria organization should establish a transport section to meet its own needs. For the immediate future, in addition to efforts to get fully operating transport organizations established in the States to meet malaria eradication needs, the following steps might be taken to minimize transport problems :

1. Where not already functioning, establish transport officer positions in each of the major states either to serve all health services or to serve exclusively the malaria eradication organization.
2. Establish at the state level a central stores for maintaining a planned inventory of hard-to-get spare parts for all vehicles and to serve as a central purchasing agent for spare parts which units cannot obtain locally. Included in central stores should be a limited number of

transmission, differential and motor assemblies to permit unit exchange when major overhauls are required. This should reduce to a minimum the "out of service" time for major overhauls.

3. Pending the establishment of a fully functioning transport organization with static and mobile workshops, fill all mechanic's positions in the units as expeditiously as possible with qualified mechanics. Provide shop space and hand tools for repairs of vehicles. When not required for work on vehicles, the mechanic and shop facilities could be used for repair of sprayers.
4. Establish rigid procedures to assure proper servicing of vehicles on schedule.
5. Provide shelters for storage of vehicles where they are not now available.
6. Review all vehicle assignments and make changes which might be indicated on the basis of the following considerations ;
   (a) Supply low maintenance vehicles to remote areas.
   (b) Equalize vehicle use by rotating vehicles between low and high use units.
   (c) Assign older vehicles to units having most convenient access to maintenance facilities and to sources of spare parts.
7. Develop specific plans for driver training and closer supervision of driving practices; with emphasis upon safety, vehicle care, and public relations.

In summary, the present fleet, plus scheduled additions, should be fully adequate to meet the transport needs of the programs. Improvements in vehicle care and maintenance and in utilization are needed to minimize operational problems.

OTHER IMPORTANT ASPECTS OF THE PROGRAM

Nomadism, border and difficult areas

The movement of people within India as observed in the visits to various states includes such problems as the seasonal shifting of population from villages to construction camps, the migration associated with increased agricultural demand for labor, the true nomads, refugees, gypsies, pilgrimages, fairs, festivals, etc. It is almost universally true that such people in malarious countries have a much higher incidence of malaria than the stable population. This is to be expected since they inevitably migrate through highly endemic areas in the course of their movement. Since they stay in the open or in temporary shelters which are unsprayed, they become foci for spread of the infection. Since they have no fixed abode, residual spraying is rarely feasible to protect the local population and seldom are they brought under the suveillance program (either active or passive). It is urgent that special effort be made to locate these people, to spray their temporary shelters with DDT, to take blood films from all fever cases and treat those found positive and to report their movements. Surveillance inpectors should be given special responsibility for their supervision and for reporting fortnightly to the Unit Officer concerning their activities with reference to migratory people. It must be recognized that migratory people will remain as one of the **important** residual foci of malaria in India and that every malaria unit (even urban) has a serious threat to the success of its eradication effort imposed by nomads of various types.

The master plan for the eradication of malaria in India reflects an estimate that 20 million people lived along the land border of India, i. e. within 10 miles of the 9,425 miles of the frontier with neighboring countries. Certain adjoining countries have well developed eradication programs, one has a program in the embryonic stage and another has one about ready to begin. While India is consistently carrying on routine residual spraying in the 20 border units it has arbitrarily determined that it will postpone initiation of surveillance for three or more years under the assumption that reintroduction of malaria will be occurring to such an extent that surveillance would break down. The Team does not believe that the latter will occur—if adequate spraying has been done for two or more years—and strongly urges reconsideration of this matter by the Advisory Committee.

In addition to the 20 "border" units the master plan set aside five additional units for a classification of "difficult" areas. Type of terrain, the presence of tribal people, the occurrence of dacoits (outlaws) and inaccessibility were factors utilized in classifying areas as "difficult" units. Unfortunately in some States advantage has been takan of this situation to fragment units and to classify a number of **scattered** areas as a "difficult unit". Such areas are under residual spraying but or not being brought under surveillance. It would appear that this is an invitation to do "sloppy work". The unit officers insist that they are achieving complete coverage. Surveillance should be initiated following two years of two rounds each of good quality residual spraying. It is recognized that certain factors may postpone the achievement of complete coverage but there is disagreement with the idea that 5 or 6 years of complete spraying must be reached **before** surveillance is initiated. If transmission is occurring within the interior of a state, it must be known. Where spraying can be carried out, surveillance can likewise be accomplished. These "difficult areas" are important residual foci and extra attention to them needs to be given. It is recommended that special consideration of these problems be given by the Advisory Committee.

Execution Of Malaria Eradication Activities Outside Of NME

The NMEP, through the state malaria services, has the responsibility for spraying coverage in all parts of India, with several notable exceptions. The following agencies have been authorized or required to carry out spraying operations with their own labor, using insecticides furnished by the NMEP :

a) Certain tea estates, principally in West Bengal and Assam
b) The several railway systems, in colonies with more than 500 persons
c) Certain urban corporations and municipalities
d) Public Works Department projects with sizeable labor colonies, and
e) The Defence establishments.

As a major tea producing area, Assam has 868 tea estates with a total population of 715,000. Division of responsibility between NMEP and private spraying operational coverage is as follows :

Management	*No. of estates*	*Population*	*Private coverage*		*NMEP Coverage*	
			No.	*Population*	*No.*	*Population*
European	434	391,110	386	327,406	48	63,704
Indian	434	323,879	55	83,536	379	240,343
TOTALS	868	714,989	441	410,942	427	304,047

In West Bengal, 111 estates under the Indian Tea Planters' Association (I.T.P.A.), with a population of 200,000, are being covered by the NMEP. The 104 West Bengal tea estates of the Indian Tea Association (ITA) are being sprayed by the owners. The tea estates in both Assam and West Bengal are asked to submit only an annual report indicating the number of rounds, houses sprayed, and population protected. These reports have been less than complete in the past and it is unrealistic to expect complete reporting in the future, even on an annual basis.

By agreement with the NMEP, eight railway systems carry out spraying operations of the houses in any of their colonies with more than 500 people, using insecticides provided by the national program. A report on 1959-60 spraying operations, including data from 7 of the 8 railways, showed that 819 houses were sprayed! Only an annual report is required from these railways. Information furnished the Evaluation Team in several states indicates that little or no NMEP supervision of the railway spraying operations is carried out. Yet the incidence of malaria in railway colonies is significantly high, according to epidemiological data submitted for the year 1959-60. Of 7,671 blood smears taken from children, 39 (or 0.50%) were positive. Of 2,677 smears from infants, 12 (or 0.45%) were positive. And of 17,210 smears taken at railway clinics, 1,046 (or 6.1%) were positive. In the case of the South Eastern Railway, the child parasite rate was 0.04%, the infant parasite rate was 2.5%, and the rate on dispensary smears was 58.1% (25 positives among 43 smears examined!)

Several large cities (corporations and municipalities) have special agreement with their States and the NMEP relative to the program for the protection of their populations. In some instances the Center and State have completely surrendered the spraying operations to the local bodies, but continue to provide DDT with less-than-ideal control as to its end-use. In other cases the State has considered it practical to use "belt" or "barrier" spraying in the peripheral area of cities, with the understanding that effective larvaciding is less than complete, and the state units have codsidered it easier to attempt spraying throughout the area than to insist on better larvaciding programs. As in other parts of the world, the refusal rate is high in urban areas of India; there has been a dangerous tendency to condone very incomplete spraying of urban homes on the assumption that such area are less favorable to malaria transmission.

India's tremendous programs of hydroelectric development and highway improvement have attracted thousands of laborers to the project areas, where the workmen and their families usually reside in sub-standard housing. The

collections of water associated with construction projects may constitue ideal breeding areas for malaria-transmitting mosquitoes. For reasons of economy the responsibility for residual spraying in construction camps has usually been delegated to the project personnel, who may not be inclined or qualified to carry out this work. Instead of giving such areas the attention they require, the state malaria organizations often dismiss as inevitable the occurrence of malaria cases from construction projects because of the employment of laborers from many different areas.

The Evaluation Team believes that in all of the above-mentioned situations, where divided responsibility may result in little or no responsibility, the "epidemiological ping-pong" now rather popular has no place in a country where all territories are simultaneously committed to malaria eradication activities. Instead, each state malaria service must exercise closer self-examination to ensure that it (a) has established specific responsibility for coverage of every geographic entity under its jurisdiction; (b) has organized an intelligence system for detecting the presence of and following the development of labor populations or other mobile groups; and (c) has directly carried out or conscientiously supervised the proper spraying of all housing structures.

Public Information Aspects of the Program

As a public health effort of great magnitude, a malaria eradication program cannot be initiated nor continued successfully without a well-informed leadership to ensure political and financial support, plus a citizenry sufficiently well-oriented to permit entree into every house for spraying, inspection and surveillance purposes. Where religious or other established social patterns hamper the work, the time limitations for precise accomplishment of malaria program phases do not permit use of long range health education techniques to hasten the acceptance of operational activities. In a program requiring repeated contacts in almost 80,000,000 households throughout India, the development and maintenance of public relations with the householders is only economically feasible through the personnel of the malaria service itself.

In addition to providing through Government channels the financial resources necessary for the malaria eradication effort, the public can greatly facilitate the field operations through enlightened collaboration. The village leader, if given the advance program of the spraying personnel, **and** another notice the day before the squad's arrival, can notify all of the householders and ensure that no locked houses will be found on a spraying day. In many countries the householders are excepted to have their houses open and ready for spraying.

with the walls cleared of obstructing material and the furniture placed in the center of the rooms. Such collaboration once or twice a year involves little trouble for the individual householder, greatly speeds up the work of the spraymen, and improves the uniformity of the coverage.

The Team is certain that parents are as anxious in India as in other countries to help safeguard the health of their children and themselves, but they can best help if the program has been explained to them. The team believes that simple explanations of the program's objectives, at hamlet and household level, by Village Level Workers of the Community Development Plan and by **all** personnel of the malaria service are much more important than the conventional radio "spots", messages projected in movie houses, newspaper publicity, or malaria posters (these have not been seen anywhere in India outside of malaria unit or subunit headquarters). Great emphasis should be placed on the importance of impressing on the householder three simple messages :

a) "Please be at home when the spraying of your village is to take place; prepare the walls and furnishings of your home for spraying and admit the sprayman when he arrives" (malaria eradication should be stressed as the sole objective of spraying, without promises of of any collateral benefits);

b) "Once your home is sprayed, do everything possible to avoid removal of the insecticidal deposits"; and

c) "If any member of your family has fever, inform the surveillance worker who visits your home, and permit the taking of a drop of blood to find out whether or not malaria is present".*

Administration

In a program of the magnitude of that being carried out in India, involving planning predominately at the Center level but depending upon State organizations for its execution, it is not surprising to find irregularities in its implementation. These stem principally from (1) unattractive salaries leading to indifferent and limited term employment; (2) failure to provide proper allowances which permit and stimulate inspections in peripheral areas necessitating overnight halts; (3) administrative complexities affecting personnel sanctions and recruitment and employment; (4) budgetary delays adversely affecting personnel and purchases of minor items and (5) procurement and logistical difficulties affecting timely delivery of supplies and equipment.

*In early October NMEP began the recruitment of health education personnel to become available to the Center, to each regional office, to each state office and to each zonal office associated with eradication program.

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COMMUNITY HEALTH CELL
LIBRARY
AND
DOCUMENTATION
UNIT

The basic problems of transport and timely delivery of bulk supplies have been resolved in an acceptable way in most instances. In contrast the attainment in a number of States of the precision required to achieve malaria eradication is still seriously hampered by administrative delays and vacillations which seriously endanger success. Disturbing examples repeatedly encountered include : immobilization of vehicles for lack of tires, difficulties of vehicle spare parts procurement, vacancies in recruitment and posting of both senior and junior personnel and extremely prejudicial delays most recently noted in setting up the surveillance network.

In summary, there has been assembled a gigantic machine conceived as and potentially capable of eradicating malaria, but which is administratively faltering or immobilized at times in certain areas.

THE FUTURE

Malaria incidence is certainly at an all-time low level in India as a whole. The occurrence of a few isolated small outbreaks or epidemics emphasizes the persistence of a residuum but the conventional malariometric indices provide too gross a measure to exactly define its occurrence in quantity and to pinpoint its geographical distribution. If active and passive surveillance can be **immediately** made effective then a careful appraisal unit by unit or even sub-unit by sub-unit will permit a critical evaluation for decisions relative to withdrawal of spraying.

There are many units which have had regular spraying operations since the National Malaria Control Program was initiated in 1953. It is true that some remote areas of the individual unit may not have received total coverage—even since the year 1958. In a number of areas no case of malaria, proven by parasitological examination, has been found in the past three years and the only presumption of occurrence is clinical diagnosis of the disease in dispensaries. This must be a challenge to the state malariologist to review the indications for further spraying or its withdrawal. The Patiala unit in the Punjab may be cited as an example. This unit has been participating in the control program since 1953. It has had two complete rounds of spraying in 1958, 1959 and 1960. There has not been a case of malaria confirmed by parasitological examination since 1953. (Few slides were taken in 1956-58 because of the merger of units). No **Anopheles culicifacies** has been located in the unit since October 1959. Actually no **A. culicifacies** has been found within the entire Punjab State during calendar year 1960. It is lamentable that active surveillance is just being initiated and that no adequate sample of slides has been received from the dispensaries but **indiscriminate continuance of spraying is inexcusable**. Evidence of transmission of malaria is the sole indication for continuation of spraying after the attack phase has been completed.

It may be anticipated that rather general spraying will be continued in India during the calender year of 1961. The team believes that only under exceptional circumstances, approved by the Center (NMEP), should more than one round of spraying be permitted in hypoendemic units. The current plan provides for two rounds in scattered foci in the 160 hypoendemic units. The population

involved is approximately 20 million, the equivalent of 20 units. The Team believes that some areas may be immediately selected for withdrawal of spraying. A careful review, at the end of the first round of spraying in 1961, of all surveillance data as well as any other recent information concerning malaria transmission should be done before any second round spraying is undertaken. It should be anticipated that substantial areas could be withdrawn from spraying at the end of the first round in 1961.

The quality of the supervision of the spraying operations should be improved from all points of view—better training of spray crews, investigation of refusals to permit spraying, more careful calibration of nozzle discharge and calculation of the quantity of insecticide applied to the structure, more uniform coverage of sprayable surface, more attention to the preparation of the dwellings for spraying, education of the public concerning the techniques and objectives of eradication and prevention of the destruction of the sprayed-surface film of residual insecticides by mud-plastering, white-washing or otherwise interfering with the treated surface. In the closing stages of the attack phase, the provision of a high quality job of spraying is of maximum importance.

If a very thorough job of spraying is carried on during the calendar year 1961 and adequate surveillance performed, it should be confidently anticipated that the extent of spraying operations in 1962 could be drastically reduced.

Surveillance, both active and passive, requires special emphasis. The newly recruited employees for this function are widely scattered over the entire country. They require constant supervision. The maintenance of a high morale and the institution of a more adequate reporting and assessment of their achievements is essential. They and their surveillance inspectors are the key to pinpointing the occurrence of malaria and permitting a concentration of the "mopping-up" activities of malaria eradication in contrast to the broadcast approach during the attack phase.

As indicated elsewhere an increase in the numbers of microscopes and laboratory technicians of the order of 75 per cent of the present budgeted staff is forecast as the minimum needs. This will not significantly increase the total costs of the program (maximum increase of 600 technicians).

The team is confident that malaria can be eradicated from India. The team will not be surprised if more malaria is uncovered by adequate surveillance than the NMEP anticipated. It is strongly felt that the failure to achieve

uniformly high quality of residual domiciliary spraying can easily account for continued transmission of the disease. In each state the units visited demonstrated great variability in the quality of spraying, in failure to spray completely the sprayable surfaces. and in the percentage of missed houses above acceptable standards.

It is therefore urgent that in 1961 there be much tighter supervision of the spraying operation, and at the same time maximum emphasis should be placed on surveillance.

In essence, India has 15 different malaria eradication programs—one in each state. No one state can achieve eradication until each of its neighboring states reaches the same point. This should lead to a federated program with no place for jurisdictional problems. The cost is enormous and each year of extension can result in great hindrance to the ultimate achievement of eradication.

Appointment of personnel, purchase of small items, etc., must receive the highest priority. Unless the Minister of Health, the Chief Minister of each State, and persons in the highest echelons of the Central Government are willing to make reasonable concessions in the interest of expediting this program, there can be no doubt that its success will be seriously jeopardized.

Dr. John Logan, Sanitary Engineer, formerly with ICA in Brazil subsequently with the Rockefeller Foundation and Director of Sardinia's Malaria Eradication program, has recently written as follows: (in his capacity as a member of ICA's expert panel on Malaria)

> "Malaria eradication involves the large scale application of a few relatively simple procedures which are based on modern research and investigation. Its success, however, lies essentially in the effectiveness and thoroughness with which these procedures are carried out. Eradication demands precision; it cannot be achieved by slipshod methods, inadequate coverage, or poorly trained and inefficient personnel. Its scientific basis is as exacting as the principle governing the design and construction of a modern hydroelectric plant."

The Team has confidence in the soundness of the plan for malaria eradication in India and the adequacy of resources for its execution. The Team is concerned, however, by the possibility that the proven techniques may not be applied consistently over the entire country with the precision upon which the

plan was based. A further concern is that complacency at vulnerable points in the attack may prevent the fullest exploitation of these resources. Both these possibilities present real threats to the timely achievement of the goal of malaria eradication in India and must be dealt with realistically during the ensuing year of the program.

ECONOMIC CONSIDERATIONS

There are several reasons why the Team has been unable to compile accurate data concerning costs of this huge operation, only a few of which will be mentioned:

1. The Government of India utilizes a fiscal year of April 1 to March 31, while the United States Government utilizes the interval of July 1 to June 30. It would be more logical to collect data on expenditures for malaria eradication on a calendar year basis (January thru December).
2. A substantial percentage of the money provided for the program is used for purchase of supplies and equipment from the United States. Inevitably several months elapse between the time that the congressional appropriation become available and the arrival of insecticides, vehicles, and other equipment and supplies at the exact locality in India where they will be utilized.
3. While expenditures by the central and state governments, via their Ministries of Health, for malaria eradication are identifiable in most instances, there are certain cases which complicate cost analysis. In some places the NMEP personnel are used for supervision in the filaria control program. In other places the costs of supervisory personnel of the malaria eradication program are charged to the general public health budget. In many municipalities and corporations (large cities) there is a mixed program of antilarval operations (largely for pest mosquito control) and domiciliary residual spraying. The cost of malaria eradication in the Defence installations, railroads, tea estate, coalfields, and public works is not comparable to the NMEP cost analysis and in some instances is not available.
4. Vehicles, spray equipment, microscopes etc. have not been capitalized and a regular depreciation charged against the annual operations.

In this dilemma the team has resorted to the unbusinesslike method of trying to develop a **per capita** expenditure for malaria eradication in India since April 1, 1958 when eradication was initiated. This means that no segregation of current operating costs from capital expenditures has been possible and therefore, this method of allocating costs has penalized the early years of the program. To reconcile the

time laps in the delay of the arrival of equipment and supplies purchased with U.S.—provided currency and the difference in the fiscal year, an arbitrary decision has been made to move forward by three months the cost of TCM purchases. Therefore the following table rapresents costs in the fiscal year of the Government of India and TCM purchases during the U.S. fiscal year. Figures for 1957-58 have been included for comparison because the foreign currency-purchased commodities were probably delivered just in time for the spraying season beginning after April 1, 1958. The reader is welcome to interpret these combinations of figures as he desires. It must also be remembered that many of the costs of the malaria control operations (1953-58) are truly a part of the preparatory phase of eradication.

TOTAL EXPENDITURES AND FUTURE ESTIMATES FOR MALARIA ERADICATION IN INDIA

Year	*Government of India Center and States Rupees (crores)*	*Dollars ('000)*	*TCM or Foreign Exchange Estimates after 1960-61 (dollars in '000)*	*Total U. S. Dollars ('000)*	*Per capita cost** (U.S. currency)*
1957-58	3.26	6,850	11,996	18,846	4.8 cents
1958-59	5.23	10,980	10,200	21,180	5.4 cents
1959-60	7.32	15,370	15,600	30,970	7.9 cents
1960-61	11.22	24,380	13,000	37,380	9.6 cents
1961-62	14.42	31,690	7,000*	38,690	9.9 cents
1962-63	10.23	20,200	3,300*	24,500	6.3 cents

The team appreciates the serious sins (from a cost accountant's point of view) of combining the figures in the above table. On an annual basis they are of little reliance. Even as an estimate of total costs for the five year period they do not take into consideration supplies and equipment on hand as of April 1,

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* Estimated foreign exchange requirements

** Population of 390,000,000 utilized.

N.B— Costs of research and training provided by the Malaria Institute of India, WHO contributions for training etc., and of UNICEF for the DDT Plant are not included. Neither are expenditures for the Ministry of Defence, public works, railroads or tea estates. These combined would probably not increase total costs as much as 15 per cent.

1958 (or obligated) nor those which might be anticipated to be on hand April 1, 1963. The only excuse for citing the unreliable statistics is the insatiable curiosity of the team to have an estimate of what malaria eradication is costing in India and what it may cost in the next two years. The end result is that we have accurate means of estimation but that the easily identifiable costs are of an unbelievably low range. If malaria eradication is being achieved with the low investment of less than one half of a rupee (U.S. 9.9 cents—see table above) per capita per year as the maximum expenditure, this is a fantastic achievement. The team believes that the improvements in spraying operations and other parts of the program recommended earlier in this report can be accomplished without any substantial increase in costs.

These amazingly low costs may be explained, at least in part, by the influence of the following factors :

1. There is a high density of population—Appendix III shows that while 82.7 per cent of the total population is classified as rural, 48.8 per cent of these people live in medium sized villages—between 500 and 2000 persons. This greatly reduces the travel time necessary to arrive at structures for spraying or for surveillance activities.
2. Labor is cheap. Wage scales vary from state to state but spraymen do not average above Rs. 55 per month (U.S. $11.50). Professional staff likewise are paid very low salaries.
3. High targets have been set to achieve spraying of 80 houses per day by two spraymen and one stirrup pump—with the part-time service of a helper for mixing. Similarly the surveillance worker is assigned a very high quota—200 houses per day. Employees of NMEP are making a serious effort to reach these goals—except in hilly, remote or otherwise difficult areas. While this probably is a factor in low unit costs, it is believed that the quality of work suffers both from lack of close supervision and from unrealistically high goals.

In comparing costs of malaria eradication in other countries these rough estimates from India are not too significant because conditions will vary enormously. Yet the modest expenditures, on a per capita basis, of the Indian program in view of its great progress must be a source of great satisfaction to the Government. It simultaneously must spur the eradication personnel to finish with the program at the earliest date. Actually this year the Government of India, in spending Rs. 19 crores, is devoting 42 per cent of its health budget to malaria eradication.

Our team is unwilling to speculate as to estimated costs beyond April 1, 1963, but believe that late in the calendar year 1961, after a year of adequate surveillance (active and passive), quite reliable forecasts should be possible. It is apparent that the India Eradication Program will not have spent more than 44 cents (U.S.) per capita or not exceeding Rs. 2.1 between April 1, 1957 and March 31, 1963 and should be approaching the maintenance phase of eradication in some areas by the latter date.

APPENDIX A

THE ORGANIZATION OF THE INDIAN NATIONAL MALARIA ERADICATION PROGRAM*

Central

The National Malaria Eradication Program of India is under the direction of the Central Organization of the Malaria Eradication Program. Execution of the program is the responsibilities of the states. The Central Organization is part of and is responsible to the Union Ministry of Health/Directorate General of Health Services. The chief functions of the Central Organization are the supervision and coordination of the compaign throughout the country, the complilation of data and the making of reports, and the evaluation of results. It assists the states and the National Malaria Institute in training activities. It determines field procedures, and makes studies on adaptations of equipment to local conditions. It makes studies on insecticide formulations and of deteriorations in transit or under local storage conditions.

A Central Working Committee establishes policy and renders decisions on questions of policy in the NMEP. This committee consists of :

1. Secretary, Ministry of Health - Chairman
2. Senior Officer of the Ministry of Finance - Member
3. Director General of Health Services - Member
4. Director, Malaria Eradication Program - Secretary.

A chart of the administrative units and relationships in the Central Organization is presented in Appendix A, Figure 1.

Regional

There are six regional organizations under the supervision of the Director of the National Malaria Eradication Program. These function as coordinating organizations and provide liaison between state organizations within the region and the Central Organization. Their main functions are :

* Information taken from "Manual of the Malaria Eradication Operation"-First Edition, issued by Malaria Institute of India, Delhi—September, 1958.

1. To assist State in the evaluation of spraying techniques and in the appraisal of results.
2. To evaluate the work of individual malaria eradication units, and to make recommendations to the state and central organizations relative to improvements.
3. To train certain categories of personnel.
4. To investigate problems such as the development of insecticide resistance in mosquitoes.

State

Each state is an adminitrative unit in the malaria eradication program. Responsibility for execution of the program in each state is assigned to the State Public Health Organization which varies from state to state. The general pattern consists of a Director of Health Services/Director of Public Health, a Deputy Director of Public Health (Malaria, Malaria and Filaria, or Insect Borne Disease) and the field Malaria Organization. A special policy level Working Committee in each State provides assistance in execution of the State program. The malaria organization consits of operating units each of which is assigned a geographic area with a population of approximately one million. Each unit is under the charge of a Unit Officer, usually a physician. In larger states, an Assistant Director (Public Health, Malaria) is in charge of 5 to 10 units. The minimum staff for each unit is shown in Appendix A, Table I. Additions to these minimums are made to compensate for such factors as hilly terrain and inadequate communications. The general pattern of State organizations is presented in Appendix A, Figure II. There are 390 units distributed by states as shown in Appendix A, Table II.

Other Organizations

In addition to the states, a number of other agencies have malaria organizations. The resources of these organizations have been incorporated in the NMEP under a variety of special administrative arrangements. NMEP plans have been carefully integrated with antilarval programs of municipal corporations where such programs exist. In some municipalities residual spraying is done by the municipal corporation malaria organization, with insecticides and technical assistance being supplied by the State organization. The Defence Department handles the program in cantonment areas, including provision of insecticides. The railway companies carry out spraying operations in all their own villeges having populations over 500, with DDT being supplied by the Central Organization. The NMEP units cover railway villages with less than 500 population. The NMEP units are responsible for surveillance in all railway villages. The

malaria organization of the Coalfield Workers Board, Ministry of Labor, carries out spraying operations in the large coalfield villages using insecticides supplied by the Central Organization. The NMEP is responsible for surveillance in all coalfield villages. The tea estates, which have malaria organizations, handle the spraying operations in their villages, with a part of the insecticides being furnished by the central organization. Tea estates which have no organization of their own are incorporated in the regular program of the NMEP units in the areas involved. NMEP will be responsible for all surveillance in tea estates.

Annual Conference of Malaria Workers

The NMEP includes provision for annual conferences of principal staff to be held each year from 1958 to 1962. The purposes of the conferences are to review critically the program as carried out each year and to determine the plan of work for the following year. The 1958 conference was held in Delhi and the 1959 conference in Jaipur. The 1960 conference will be held in December in Hyderabad. Attendance at the conference usually runs about 500, with representatives from the various states, centrally administrated territories, Railways, Inter-State organizations, tea estate organization, the Damodar Valley Corporation, the Technical Cooperation Mission (ICA), and WHO. There is a special working committee which holds quarterly meetings to consider technical problems. The Director General of Health Services serves as Chairman. Members of the committee are representatives from the Technical Cooperation Mission (ICA), WHO, Defence, Railways, and Ministry of Health. The Director of NMEP is the Secretary.

Appendix A—Table I

STAFFING PATTERN FOR A MALARIA ERADICATION UNIT

NMEP—INDIA

Position	*Number*
Malaria Officer	1
Assistant Unit Officer non-medical in-charge of spraying logistics	1
Senior Malaria Inspectors	4
Malaria Inspectors	4
Technicians	2
Accountant	1
Store Keeper	1
Upper division clerk	1
Mechanic	1
Motor Drivers	5
Motor cleaners	5
Peons	4
Chowkidar	1
Sweeper	1
Superior Field Workers for 12 months	4
Field Workers for 12 months	10
Surveillance inspectors	25
Surveillance workers	100

	Endemic Unit in plains	*Endemic Unit in Hills*	*Hypo-endemic Unit*
Superior field worker for 5 months	32	44	—
Superior field worker for 2 months	—	—	32
Field worker for 5 months	170	230	—
Malaria field worker for 2-5 months	—	—	170

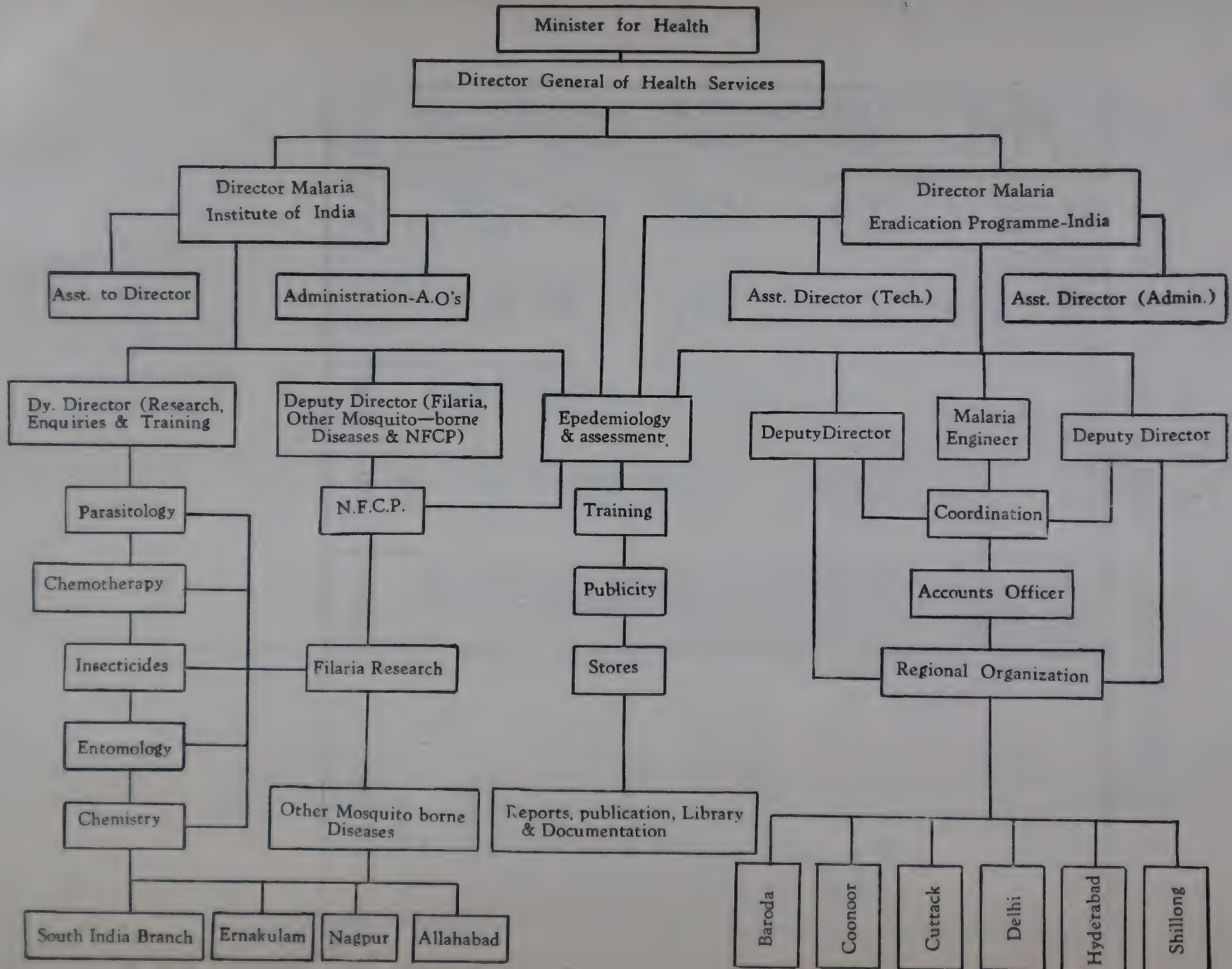
Appendix A - Table II

DISTRIBUTION OF NMEP UNITS BY STATES

STATE	Estimated Population 1957 (millions)	Units activated prior to 1958		Units activated during & since 1958		Total number of units
		Plains Area Units	Difficult Area Units	Plains area units	Difficult area units	
Andhra	33.50	9 00	—	—	24.50	33.50
Assam	9.90	10.00	4.00	—	—	14.00
Bihar	42.90	15.00	5.00	—	22.00	42.00
Delhi	2.00	2.00	—		—	2.00
Gujarat	19.00	—	—	—	—	19.00
Himachal Pradesh	1.20	--	1.25	—	—	1.25
Jammu & Kashmir	4.80	--	1.00	—	1.00	2.00
Kerala	15.00	1.50	1.00	1.00	11.00	14.50
Madhya Pradesh	28.70	15.50	7.00	3.00	3.50	29.00
Madras	33.00	2.70	1.00	—	27.75	31.45
Manipur	0.70	2.00	—	—	—	2.00
Maharashtra	33.50	—	—	—	—	33.50
Mysore	20.90	13.63	1.00	—	4.50	19.13
Orissa	14.60	6.50	4.00	—	4.00	14.50
Punjab	17.40	7.00	2.00	2.00	7.00	18.00
Rajasthan	17.60	6.67	2.00	1.00	7.00	16.67
Tripura	0.90	—	1.00	—	—	1.00
Uttar Pradesh	69.50	19.00	6.00	15.00	27 00	67.00
West Bengal	28.80	20.00	3.00	—	3.00	26.00
NEFA	0.60	—	0.25	1.00	0.75	2.00
Sikkim	0.15	—	0.50	—	—	0.50
Coalfields	—	1.00	—	—	—	1.00
TOTALS	394.05	160.00	40.00	30.00	160.00	390.00

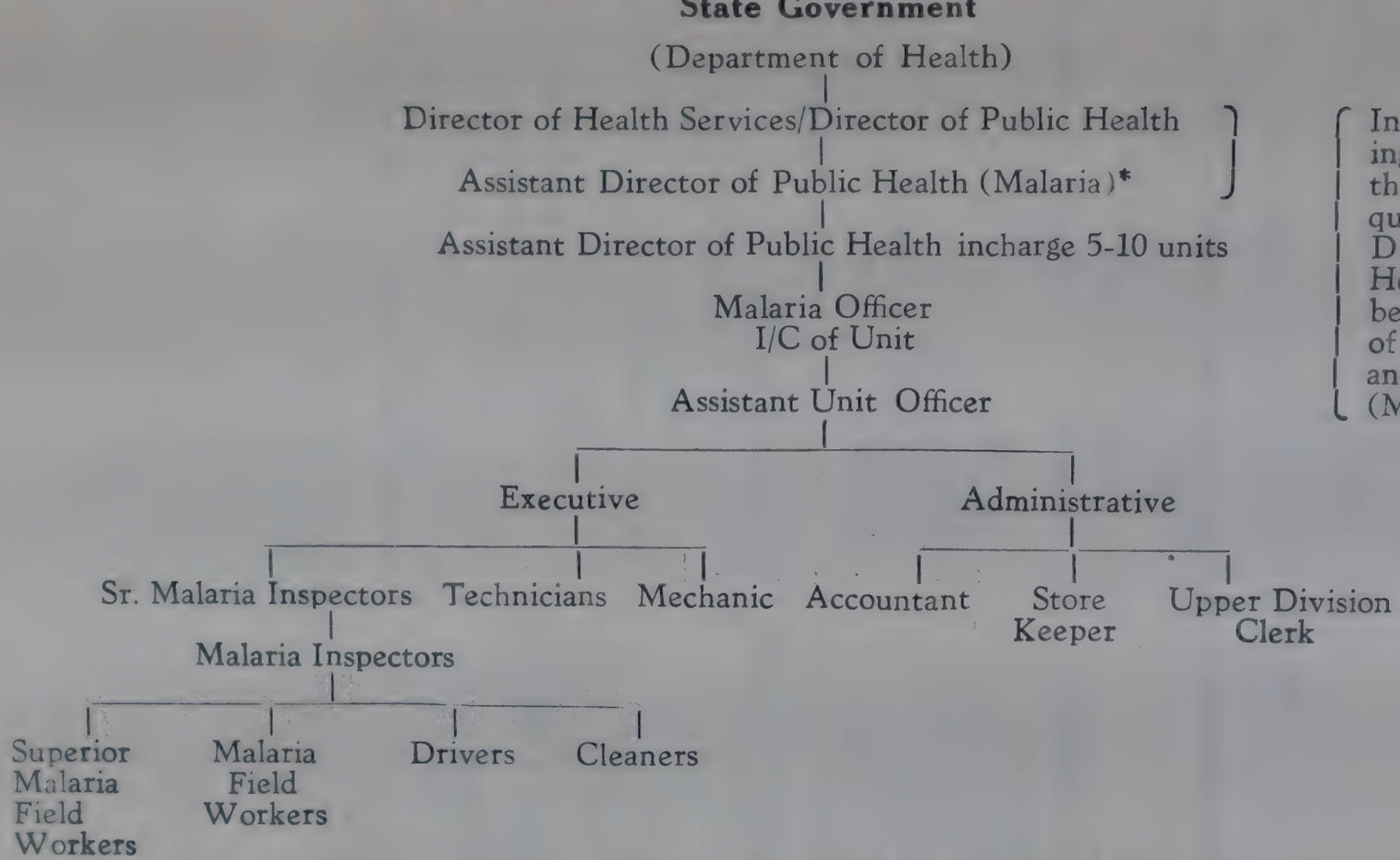
Appendix A - Figure 1

CENTRAL ORGANIZATION FOR MALARIA ERADICATION



Appendix A—Figure 2

STATE ORGANIZATION FOR MALARIA ERADICATION



In case of States having 20 or more units, there will be at headquarters a Deputy Director of Public Health (Malaria)* between the Director of Health Services and the A. D. P. (Malaria)

*In some States the head of the Malaria Section is designated as State Malariologist.

Appendix B

SUMMARY OF DATA FOR THE STATE OF ANDHRA PRADESH WITH HEADQUARTERS AT HYDERABAD

Visit made from 20/10/60 to 24/10/60 by Team members : E. H. Hinman & Thomson

No. of State Sub-divisions or regions : 5

Population	*State Total*	*At risk*
in 1951 ...	... 31,260,133 ...	... 31,260,133
in 1960 (est). ...	... 37,210,000 ...	... 37,210,000

No. of Malaria units (1960-61) : Endemic, 9; Hypoendemic, 24.5; Total 33.5

Summary (Quantitative) of Spraying since initiation of Eradication Program

		Endemic units	*Hypoendemic units*	*All units*
Houses reached (1959-60)	...	2,122,098	6,560,321	8,682,419
Percentage sprayed in :				
1958-59 ROUND I	...	58-99%	nil	
ROUND II	...	83-98%	nil	
1959-60 ROUND I	...	84.8-99.3%	90-99%	
ROUND II	...	89.3-98.7%	nil	
1960-61 ROUND I	...	—	Under spraying	

Consumption of Insecticides (All figures in pounds)

	DDT Tech.	*DDT 75%*	*DDT 50%*	*BHC*
Amount used in 1958-59.	—	1,133,436	nil	nil
Amount used in 1959-60.	—	2,846,965	637,871	8,343
Amount used in 1960 (Rd. 1) Sep. 60	—	2,167,073	656,967	—
Stock position Oct. 1, 1960		(under spraying)		

Vehicles and Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated (Not yet received)*
Jeep Station Wagons ...	2 ...	—
Jeep ¼ ton ...	38 ...	5
Jeep trucks ...	110 ...	—
Dodge trucks ...	16 ...	—
Dodge power wagons ...	20 ...	—
Others ...	— ...	—
TOTALS ...	186 ...	5

Vehicle maintenance facilities : None

No. of Sprayers on hand : Stirrup pumps : 3,078; Hand Compression : 1,539
Does State Malaria Services have central shop for sprayer repair and/or reconditioning? No, but every unit is provided with a mechanic.

ASSESSMENT

Entomological Assessment Activities

At State Level

Personnel Entomologists. 2; Insect Collectors, 2.

No. of villages in which adult susceptibility tests have been accomplished since January 1, 1960 : Impregnated paper received in the last week of September, 1960. No experiment conducted.

Total tests performed : 0

Malariometry

"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submitted by Institutions of each type, during period Sep.1, 1959 to Aug.31, 1960*
Base hospitals	... 20	Total slides : 804 received from hospitals and dispensaries
District hospitals	... 26	
Dispensaries	... 225	
Primary H. Centers	... 169	
Others	... 358	
TOTALS	... 828	804

"Active" Surveillance Field Surveillance Personnel (as of Oct. 1, 1960).

Category of employee	*No. sanctioned*	*No. trained*	*No. actually at work in field*
Surveillance Inspectors	788	75%	75%
Surveillance workers	3,150	90%	90%

Number (and percentage) of units fully staffed and in field operation as of Oct. 1, 1960 : No. nil; % of total units : 75 to 80%.

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBERS

	Name	*Date*
NMEP Regional Officer:	Dr. K. L. Mukerji	Oct. 20-24
Minister of Health (State)	Mr. P. V. G. Raju	Oct. 21
Director of Pub. H. (State)	Dr. C. R. Naidu	Oct. 20-22
Asst. Dir. of P. H. for Malaria:	Dr. Manikchandra	Oct. 20-24

Field Observations:

				Activities observed		
Date	*Unit*	*Sub-unit*	*Locality*	*Hqs.*	*Spraying*	*Surv.*	*Ent. Coll.*
Oct. 21	ZONE HQS		Hyderabad	×			
	Hyderabad	Hyderabad	„	×			
	„	„	„		×	×(Passive)	
Oct. 22	Vijayawada Zone	Headquarters					
	Vijayawada	Kondapally	Idupogollu		×(Calibration)		
	Masulipatam			×			
	„	Masulipatam		×		×	
	„	„	Mangunipuda V.				×
Oct. 23	Vijayawada	Vijayawada	Vijayawada	×		×	

Special local problems and/or general comments:

Outbreak in Hyderabad—Oct. 13. Total of 1112 slides taken. 514 examined revealed 88 positive (3/4 **P. falciparum**). Epidemic at Nagarjunasagar Dam Oct. 14—200 positive out of 350 examined from 35,000 workers and dependents (½ **P. falciparum**).

Slow recruitment of surveillance workers possibly not functioning till April, 1961 on statewide basis (according to Director). No use of WHO kits for susceptibility tests need night collections inside and outside of sprayed houses to get adults. Need better coordination with medical services for dispensaries fever cases.

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SUMMARY OF DATA FOR THE STATE OF ASSAM WITH HEADQUARTERS AT SHILLONG

Visit made from October 30, 1960 to November 2, 1960 by Team Member: D.J.Pletsch

No. of State Sub-divisions ("Zones" or "Regions") : Three

Population	*State Total*	*At Risk*
in 1951	9,043,707	9,043,707
in 1960 (est.)	9,955,863	9,955,863

No. of Malaria Units (1960-61): Endemic 13.25; Hypoendemic: 0. Total: 13.25

Summary (Quantitative) of Spraying since Initiation of Eradication Program

	Endemic Units	*Hypo-endemic Units*	*All Units*
Houses (or structures) reached (1959-60)	5,430,594	0	5,430.594

Percentage sprayed in :

1958-59 ROUND I	49.0%	0	49.0%
ROUND II	79.8%	0	79.8%
1959-60 ROUND I	89.1%	0	89.1%
ROUND II	97.9%	0	97.9%
1960-61 ROUND I	(Complete data not yet available)		

Consumption of Insecticides (All figures in pounds)

	DDT Tech.	*DDT 75%*	*DDT 50%*	*BHC*
Amount used in 1958-59	—	1,529,105	19,785	10,466
Amount used in 1959-60	—	1,913,401	492	50,261
Amount used in 1960 (Rd. I)	(Complete data not yet available)			
Stock position Oct. 1, 1960	(Complete data not yet available)			

Vehicles And Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated (Not yet received)*
Jeep Station Wagons	1	0
Jeep ¼ ton	15	1
Jeep trucks	17	1
Dodge trucks	0	0
Dodge power wagons	46	–
Others	0	0
TOTALS	79	2

Vehicle maintenance facilities : None; done through private shops.

No. of Sprayers on hand : Stirrup pumps : 1329 (267 unserviceable)
Hand compression : 834 (168 unserviceable)

Does State Malaria Service have central shop for sprayer repair and/or reconditioning? No, minor repairs done locally.

ASSESSMENT

Entomological Assessment Activities
At State Level

Personnel : Entomologists : 1; Insect Collectors : 4.

No. of villages in which adult susceptibility tests have been accomplished since January, 1, 1960. ? Total Tests performed : ?

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Malariometry

"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submited by institutions of each type, during period Sept. 1, 1959 to Aug. 31, 1960*
Base hospitals District hospitals Dispensaries Primary H. centers Others	Data not furnished	0
TOTALS		0

"Active" Surveillance Field Surveillance Personnel (as of Oct. 1, 1960)

Category of employee	*No. sanctioned*	*No. trained*	*No. actually at work in field*
Surveillance Inspectors	269	(Training commences	0
Surveillance Workers	1,075	November 1, 1960)	0

Number (and percentage) of units fully staffed and in field operation as of October 1, 1960 : No. 10.75 from Nov. 1, 1960; % of total units : 81.1.

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBER

	Name	*Date*
NMEP Regional Officer :	Dr. Somasunda Rao	October 30/Nov. 2
Minister of Health (State)	—	—
Director of Pub. H. (State)	—	—
Dep. Dir. of P. H. for Malaria	Dr. C. P. Dutta	October 30/Nov. 2

Field Observations

Date	*Unit*	*Sub-unit*	*Locality*	*Activities observed*			
				Hqs.	*Spraying*	*Surv.*	*Ent. Coll.*
Oct. 30	State Service	—	Shillong	x	...	...	...
Oct. 31	Shillong	Nongpoh	Nongpoh	x	...	...	...
,,	Gauhati	Dudhnoi	Chaudhuri	...	x	...	...
,,	,,	—	Gauhati	x	...	...	...
Nov. 1	Nalbori	—	Nalbori	x	...	...	...
,,	,,	Nalbori	,,	x	...	...	...
,,	,,	,,	Sagarkuchi	...	x	...	...
,,	,,	,,	Khatikuchi	...	x(ind*.)	...	...
,,	,,	,,	Kayakuchi	...	x(ind*.)	...	...
,,	Tangla	Rangiya	Bhaghmara	...	x(ind*.)	...	...
Nov. 2	Gauhati	Raha	Manipur	...	x	...	...

*Inspection of already-sprayed houses.

Special local problems and/or general comments :
Houses very much scattered in hill areas
Majority of families have 3 or 4 sprayable structures
Lack of tires has paralyzed transport
Silkworm culture (cottage industry) increases refusals in many rural areas
S. W. border with unsprayed areas of Pakistan hinders consolidation

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SUMMARY OF DATA FOR THE STATE OF BIHAR WITH HEADQUARTERS AT PATNA

Visit made from Oct. 23 to Oct. 29, 1960 by Team Member : D. J. Pletsch
No. of State Sub-divisions ("Zones" or "Regions") : Four

Population	*State Total*	*At Risk*
in 1951	... 39,000,000	... 39,000,000
in 1960 (est.)	... 42,000,000	... 42,000,000

No. of Malaria Units (1960-61) : Endemic, 20; Hypoendemic, 22; Total, 42.

Summary (Quantitative) of spraying since Initiation of Eradication Program

	Endemic units	*Hypoendemic units*	*All units*
Houses or structures reached, 1959-60	5,025,141	3,590,459	8,615,600
Percentage sprayed in :			
1958-59 ROUND I	93.7	--	93.7
ROUND II	91.0	--	91.0
1959-60 ROUND I	98.6	98.1	98.4
ROUND II	98.0	97.1*	98.0
1960-61 ROUND I	(Data not yet consolidated)		

*Part of Nawada unit.

Consumption of insecticides (All figures in pounds)

	*DDT Tech.**	*DDT 75%*	*DDT 50%**
Amount used in 1958-59	—	3,638,911	—
Amount used in 1959-60	—	5,569,847	—
Amount used in 1960 (Rd. I)	(complete data not yet available)		
Stock position Apr. 1, 1960	—	689,760	—

*All Insecticides stated in terms of DDT 75%.

Vehicles and Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated (Not yet received)*
Jeep station wagons	2	—
Jeep ¼ ton	42	19
Jeep trucks	117	—
Dodge trucks	5	—
Dodge power wagons	61	—
Others (Studeb. 3 ton)	14	—
TOTALS	241	19

Vehicle maintenance facilities : Malaria service uses public health garages for Hqs. vehicles, and for vehicles of those units within range of such service. Each unit has "mechanic" for minor repairs; each unit officer has blanket authorization for contracting repairs with commercial shops.

No. of sprayers on hand : Stirrup pumps, 4788 (639 are unserviceable).
Hand compression, 2184 (507 are unserviceable).

Does State Malaria Service have central shop for sprayer repair and/or reconditioning? Sprayer repairs are done locally by mechanic of each unit.

ASSESSMENT

Entomological Assessment Activities
At State Level

Personnel Entomologists : 2; Insect Collectors, 2+3 lab. assts.

No. of villages in which adult susceptibility tests have been accomplished since January, 1, 1960 : 0 ("Don't find enough anophelines").

Total tests performed : 0.

Malariometry
"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submitted, by institutions of each type, during period Sep.1, 1959 to Aug.31,1960*
Base hospitals	... 2	
District hospitals	... 17	
Dispensaries	... 685	
Primary H. centers	... 356	
Others	... —	
TOTALS	... 1,060	

"Active" Surveillance Field Surveillance personnel (As of Oct. 1, 1960)

Category of employee	*No. sanctioned*	*No. trained*	*No. actually at work in field*
Surveillance Inspectors	1,000	1,000	Majority are still working on house "census".
Surveillance workers	4,000	4,000	

Number (and percentage) of units fully staffed and in field operation as of Oct. 1, 1960 : No. 40 ; % of total units : 95.2%.

CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBER

	Name	*Date*
NMEP Regional Officer	... Dr. A. K. Chakrabarti	Oct. 25-29, 1960
Secretary of Health (State)	... Mr. N. P. Mathur	Oct. 24
Director of Pub. H. (State)	... Dr. S. M. Husain	Oct. 24
Dep. Dir. of P. H. for Malaria	... Dr. S. B. Lal	Oct. 23-29

Field Observations :

Date	*Unit*	*Sub-unit*	*Locality*	*Activities observed*			
				Hqs.	*Spraying*	*Surv.*	*Ent. Coll*
Oct. 23	State Malaria Office		Patna	x	—	—	—
„ 25	Nawada	—	Nawada	x	—	—	—
„ 25	Nawada	Nawada	Nawada	x	—	—	—
„ 25	Nawada	Rajgir	Rajgir	x	x(ind)	—	—
„ 25	Nawada	Nawada	Masanganj	—	x(ind)	—	—
„ 25	Giridih	Kodarma	Kodarma	x	—	—	—
„ 25	Giridih	Kodarma	Barwadih	—	x(ind)	—	—
„ 25	Hazaribagh	—	Hazaribagh	x	—	—	—
Oct. 26	Hazaribagh	Hazaribagh	Khasi-khab	—	x(ind)	—	—
„ 26	Hazaribagh	Ramagarh	Ramagarh	x	—	—	—
„ 26	Hazaribagh	Ramagarh	Moramkalam	—	x(ind)	—	—
„ 26	Hazaribagh	Ramagarh	Irba	—	x(ind)	x	—
„ 26	Ranchi	—	Ranchi	x	—	—	—
Oct. 28	Muzaffarpur	—	Muzaffarpur	x	—	—	—
„ 28	Muzaffarpur	Shakara	Pilkhi	—	x(ind)	—	—
„ 28	Muzaffarpur	Shakara	Mirapur	—	x(ind)	x	—
„ 28	Muzaffarpur	Shakara	Bholi	—	x(ind)	—	—
„ 28	Motipur	—	Rohua	—	x(ind)	—	—
„ 28	Motipur	—	Bhatolia	—	x(ind)	—	—
„ 28	Darbangha	—	Darbangha	x	—	—	—
„ 28	Darbangha	Darbangha	Ranitol	—	x(ind)	—	—
„ 28	Darbangha	Darbangha	Sunderpore	—	x(ind)	—	—
„ 28	Darbangha	Darbangha	Nanaura	—	x(ind)	—	—

Special local problems and/or general comments :
Despite reinforcement of personnel, two units in South Bihar have been

unable to achieve complete spraying coverage of widely dispersed houses in hilly areas.

Lack of total coverage in the Nepal program creates special problems in the North Bihar border areas.

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SUMMARY OF DATA FOR THE DELHI STATE WITH HEADQURTERS AT DELHI

Visit made on September 27, 1960 by Team Members : E. H. Hinman, F. E. Gartrell and D. J. Pletsch.

No. of State Sub-divisions ("Zones" or "Regions") 5

Population	*State Total*	*At risk*
In 1951	... 1,744,072	... 1,744,072
In 1960 (est.)	... 2,454,196	... 2,454,196

No. of Malaria units (1960-61) : Endemic : 2

Summary (Quantitative) of Spraying since Initiation of Eradication Program

	Endemic Units
Houses reached (1959-60)	... 244,475
Percentage sprayed in :	
1958-59 ROUND I	... 60.1%
ROUND II	... 54.2%
1959-60 ROUND I	... 84.8%
ROUND II	... 95.5%
1960-61 ROUND I	... 95.4%

Consumption of Insecticides (All figures in pounds)

	DDT 75%	*DDT 50%*
Amount used in 1958-59	... 215,243	... —
Amount used in 1959-60	... 355,038	... 11,306
Amount used in 1960 (Rd. I)	... 195,907	—
Stock Position Oct. 1, 1960	... 28,256	

Vehicles and Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated (Not yet received)*
Jeep Station Wagons	... 1	... —
Jeep ¼ ton	... 2	... 2
Jeep trucks	... 4	... —
Dodge Trucks	... 8	... —

Dodge power wagons	... —	.. —
Others	... —	... —
TOTALS	... 15	... 2

Vehicle maintenance facilities : Repairs are made at Central Workshop of Delhi State.

No. of Sprayers on hand : Stirrup Pumps : 141
Hand compression : 87

Does State Malaria Service have central shop for sprayer repair and/or reconditioning? **Yes.**

ASSESSMENT

Entomological Assessment Activities
At State Level

Personnel Entomologists : **0**; Insect Collectors : 16 including Inspectors for anti-larval checking

No. of villages in which adult susceptibility tests have been accomplished since January 1, 1960 : **0**

Total tests performed : **0**

Malariometry
"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submitted, by institutions of each type, during period Sep.1,1959 to Aug.31,1960*
Base hospitals	"Partial passive surveillance work is being carried out at present"	
District hospitals		
Dispensaries		
Primary H. Centers		
Others		

"Active" Surveillance Field Surveillance Personnel (As of Oct. 1, 1960)

Category of employee	*No. sanctioned*	*No. trained*	*No. actually at work in field*
Surveillance Inspectors	50	10	10
Surveillance workers	200	30	30

"Active Surveillance work has commenced in two zones of Delhi"

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBERS

	Name	*Date*
NMEP Regional Officer	Dr. Bhatia	Sep. 27, 1960
Health Officer of Delhi	Dr. M. S. Boparai	,,
Delhi Anti-malaria officer	Dr. O. P. Bhasin	,,

Field Observations :

				Activities Observed			
Date	*Unit*	*Sub-unit*	*Locality*	*Hqs.*	*Spraying*	*Surv.*	*Ent. Coll.*
Sep. 27	Delhi Office		Delhi	x	—	—	—
,,	Delhi	Narela	Kherakalan	—	x	—	—

Special local problems and/or general comments :

Fever case surveys have been made in "suspect" villages for the past 2 years.

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SUMMARY OF DATA FOR THE STATE OF GUJARAT WITH HEADQUARTERS AT AHMEDABAD

Visit made from Oct. 7 to Oct. 11, 1960 by Team Members : E. H. Hinman, F. E. Gartrell and D J. Pletsch.

No. of State Sub-divisions ("Zones" or "Regions") : Two.

Population	*State Total*	*At Risk*
in 1951	16,262,135	16,262,135
in 1960 (est.)	18,021,863	18,021,863

No. of malaria units (1960-61): Endemic, 12.5; Hypoendemic, 7; Total, 19.5

Summary (Quantitative) of Spraying since Initiation of Eradication Program

	Endemic units	*Hypoendemic units*	*All units*
Houses "targeted" (1959-60)	2,515,230	1,391,895	3,907,125
Percentage sprayed in :			
1958-59 ROUND I	83.5%	72.2%	81.3%
ROUND II	85.6%	69.7%	84.1%
1959-60 ROUND I	86.6%	82.0%	84.9%
ROUND II	91.9%	95.4%	92.3%
1960-61 ROUND I	87.7%	95.1%	89.9%

Consumption of Insecticides (All figures in pounds)

	DDT Tech.	*DDT 75%*	*BHC*
Amount used in 1958-59	176,573	1,617,587	227,499
Amount used in 1959-60	168 993	2.128.946	36.595
Amount used in 1960 (Rd. I)	96,496	1,206,076	168,596

Stock position Oct. 1, 1960: Not available

Vehicles and Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated (Not yet received)*
Jeep Station wagons	2	1
Jeep ¼ ton	22	6
Jeep trucks	42	—
Dodge trucks	30	—
Dodge power wagons	12	—
Others	7	—
TOTALS	115	7

Vehicle maintenance facilities: No, matter is under consideration.

No. of Sprayers on hand: Stirrup pumps: 3035; Hand Compression; 546

ASSESSMENT

Entomological Assessment Activities

At State Level

Personnel Entomologists: 2

No. of villages in which adult susceptibility tests have been accomplished since January 1, 1960: 15

Total tests performed: 2 in each village

Malariometry

"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*No. sending Slides*	*Total No. of blood films submitted, by institutions of each type, during period Sep. 1, 1959 to Aug. 31, 1960*
Base hospitals	—	273	3,742 of which 57 were positive
District hospitals	320		
Dispensaries	80		
Primary H. Centers	167		
D.L.B. Dispensaries	309		
Charitable dispensaries	127		
Private practitioners	2584	431	

"Active" Surveillance Field Surveillance Personnel (as of Oct. 1, 1960)

Category of employee	*No. sanctioned*	*No. trained*	*No. actually at work in field*
Surveillance Inspectors	475	441	441
Surveillance workers	1,900	1,685	1,685

Number (and percentage) of units fully staffed and in field operation as of Oct. 1, 1960 : No. 18; % of total units : 95%

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBERS

	Name	*Date*
NMEP Regional Officer	Dr. J. Rahman	Oct. 7-11
Minister of Health (State)	—	—
Director of Pub. H. (State)	Dr. T. B. Patel	Oct. 7-8
Dep. Dir. of P. H. for Malaria, Acting :	Shri N. D. Mehta	Oct. 7-11

Field Observations

				Activities Observed			
Date	*Unit*	*Sub-unit*	*Locality*	*Hqs.*	*Spraying*	*Surv.*	*Ent. Coll.*
Oct. 7	State Office		Ahmedabad	x	—	—	—
„ 8	Kaira	—	Kaira camp	—	x	—	—
„	„	—	Vitthalpur	—	x	x	—
„	„	—	Nadiad	x	—	—	—
„			Birpur	—	x	—	—
Oct. 9	NMEP Regional Office		Baroda	x	—	—	—
„	WHO Adv. Team M.E.#2		„	x	—	—	—
„	Municipal Coord. Unit		„	x	—	—	—
„	Baroda	—	„	x	—	—	—
„	„	Karjan	Gavasia	—	x	—	—
Oct. 10	Godhra	—	Godhra	x	—	—	—
„	„	Godha	Kakanpura	—	x	—	—
„	„	„	Salia	—	—	x	—
„	WHO ATME #2 (Field)		Baria	—	—	—	x
Oct. 10	Surat	—	Surat	x	—	—	—
„	„	Bardi	Niol	—	x	—	—

Special local problems and/or general comments

Resistance of **A. culicifacies** to DDT has been indicated by recent susceptibility testing in the Panchmahal area.

Despite the administrative complexities associated with bifurcation, and the recent establishment of Gujarat State, the malaria service has made commendable progress in initiating its surveillance work.

SUMMARY OF DATA FOR THE STATE OF KERALA WITH HEADQUARTERS AT TRIVANDRUM

Visit made from 20/10/60 to 23/10/60 by Team Member: Dr. F. E. Gartrell

No. of State Sub-divisions ("Zones" or "Regions") : 2

Population	*State Total*	*At Risk*
in 1951	14.5 millions	3.5 millions
in 1960 (est)	16.0 millions	4.0 millions

No. of malaria units (1960-61) : Endemic, 3.5; Hypoendemic, 11; Total, 14.5.

Summary (Quantitative) of spraying since Initiation of Eradication Program

	Endemic units	*Hypoendemic units*	*All units*
Houses reached (1959-60)	690,125	1,582,007	2,272,132
Percentage sprayed in :			
1958-59 ROUND I	93.4%	--	--
ROUND II	95%	--	--
1959-60 ROUND I	96.8%	86%	--
ROUND II	96.3%	No Second round	
1960-61 ROUND I	Spraying due to start on 1-11-60 in endemic units and 16-1-61 in hypoendemic units.		

This covers only 9 hypoendemic units out of 11. 2 units were not started in 59-60. Spraying due in 11 hypoendemic and 3½ endemic units in 1960-61.

Consumption of Insecticides (all figures in pounds)

	DDT Tech.	*DDT 75%*	*DDT 50%*	*BHC*
Amount used in 1958-59		460,905		24,088
Amount used in 1959-60		970,833	50,393	5,570
Amount used in 1960 (Rd. I)	To be started on 1-11-60 only as malaria season is from February to June.			

Vehicles and Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated (Not yet received)*
Jeep Station wagons	1	—
Jeep ¼ ton	12	4
Jeep trucks	53	—
Dodge trucks	—	—
Dodge power wagons	4	—
Others, trucks	4	—
TOTALS	74	4

Vehicle maintenance facilities: None; under cosideration.

No. of sprayers on hand : Stirrup pumps : 1,422

Hand compression : 711

Does State Malaria Service have central shop for sprayer repair and/or reconditioning? No

ASSESSMENT

Entomological Assessment Activities

At State level

Personnel Entomologist : 1 ; Insect Collectors: 0

No. of villages in which adult susceptibility tests have been accomplished since January 1, 1960 : 0 Total tests performed : 0

Malariometry

"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submitted, by institutions of each type, during period Sep.1,1959 to Aug.31,1960*
Base hospitals	2	none
District hospitals	9	none
Dispensaries	134	none
Primary H. centers	76	none
Others	126	
TOTALS	347	

"Active Surveillance Field Surveillance Personnel (as of Oct. 1, 1960)

Category of employee	*No. sanctioned*	*No. trained*	*No. actually at work in field*
Surveillance inspectors	264	nil	nil
Surveillance workers	1136	264	262 (2 left service)

Number (and percentage) of units fully staffed and in field operation as of October 1, 1960 : No. 1 ; % of total units : 7%

Two more hypoendemic units sanctioned in April, 1960 have only partial staff as on 1-10-60.

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBER

	Name	*Date*
NMEP Regional Officer:	Dr. H. Shantaram (Asst. Dir. Ent.)	10/20-10/23
Director of Pub. H. (State)	Dr. T. B. Menon.	10/20&10/23
Dep. director of P.H. for Malaria.	Dr. C. Joseph	10/20-10/23
Zonal Medical Officer, Kottayam.	Dr. Subramanyam	10/22

Field Observations:

					Activities observed		
Date	*Unit*	*Sub-unit*	*Locality*	*Hqs.*	*Spraying*	*Surv.*	*Ent. Coll.*
10/21	Trivandrum I		Trivandrum	x		x	
10/21		Neyattinkara		x		x**	
10/21	Trivandrum II			x		x	
10/21		Chiraginkih		x		x	
10/21	Quilon		Quilon	x		x	
10/22	Chengannur		Alleppy Dist.	x		x	
10/22		Chengannur	„	x		x	
10/22	Kottayam		Kotayam	*			

*Conference only with Unit Officer (Entomologist) at Chengannur

**Observed field work and reveiwed data. At other locations reveiwed data and discussed surveillance procedures with unit staff.

Special local problems and/or general comments

The two zonal Assistant Directors of Health Services are responsible for supervision of the malaria eradication program and the filaria control program. Nine of the unit officers are entomologists. Two deputy unit chief positions are vacant and are not yet sanctioned.

It was reported that because of the virtual absence of malaria in the hypoendemic areas, there is little interest on the part of the general population in having their houses sprayed. This, coupled with lack of abatement of mosquito and other insect nuisances by DDT spraying, account for many refusals. Annual rethatching of roofs, and the belief on the part of many of the householders that insect damage to roofs is greater after DDT spraying, poses another problem. The usual problem of washing and/or replastering of walls is also encountered.

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SUMMARY OF DATA FOR THE STATE OF MADHYA PRADESH WITH HEADQUARTERS AT INDORE

Visit made from Oct. 25 to Oct. 29, 1960 by team members: Dr. E. H. Hinman and Mr. Thomson.

No. of state sub-divisions ("zones" or "regions") : 3

Population	*State Total*	*At Risk*
in 1951	2.61	2.61
in 1960 (est.)	2.81	2.81

No. of Malaria units (1959-60) : Endemic, 25.50; Hypoendemic, 3.50; Total, 29.00

Summary (Quantitative) of Spraying since Initiation of Eradication Program

	Endemic units	*Hypoendemic units*	*All units*
Houses reached (1959-60)	6,020,532	927,948	6,948,484
Percentage sprayed in:			
1958-59 ROUND I	86.12	0	86.92
ROUND II	35.18	0	35.18
1959-60 ROUND I	96.15	92.4	95.1
ROUND II	88.08	14.0	85.65
1960-61 ROUND I	97.50	94.2	—

From 21 Endemic units information from 4.5 endemic units not available. From 3 Hypoendemic units information from 0.5 hypoendemic units not available.

Consumption of Insecticides (All figures in pounds)

	DDT Tech.	*DDT 75%*	*DDT 50%*	*BHC*
Amount used in 1958-59	0	2,364,882	137,363	204,563
Amount used in 1959-60	0	4,124,814	926,069	161,062

Stock position Oct. 1, 1960 — Not available as full information from some units has not been received.

Vehicles and Equipment

Vehicles on hand	*On hand Oct 1, 1960*	*Allocated (not yet recd)*
Jeep Station wagons	3	—
Jeep ¼ ton	30	20
Jeep trucks	36	3
Dodge trucks	35	—
Dodge power wagons	54	—
Others	—	—
TOTALS	158	23

Vehicles maintenance facilities : None

No. of sprayers on hand : Stirrup pumps, 2446, Hand Compression : 1356

Does State Malaria Service have central shop for sprayer repair and/or reconditioning? No.

ASSESSMENT

Entomological Assessment Activities

At State Level

Personnel Entomologist, 1; Insect Collectors, 4.

No. of villages in which adult susceptibility tests have been accomplished since January 1, 1960 : 9.

Total tests performed : 14

Malariometry

"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submitted, by institutions of each type, during period Sep. 1, 1959 to Aug. 31, 1960*
Base hospitals	4	0
District hospitals	35	0
Dispensaries and hospitals	665	6956
Primary health centers	115	—
Others	—	—
TOTALS	819	6956

"Active" Surveillance

Field Surveillance Personnel (as of Oct. 1, 1960)

Category of employee	*No. Sanctioned*	*No. trained*	*No. Actually at work in field*
Surveillance Inspectors	675	625	625
Surveillance Workers	2700	2700	2700

Number (and percentage) of units fully staffed and in field operation as of Oct. 1 1960; No. 29; % of total units, 100.

Note - It is pointed out that large number of surveillance inspectors and workers resign the job after joining the post. Hence there is great turn over of the personnel. Arrangements are immediately made to recruit new substitutes.

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBER

	Name	*Date*
NMEP Regional Officer	Dr. Mukerji	Oct. 24-29
Minister of Health (State)	Rani Padmavati Devi (woman)	
Director of Pub. H. (State)	Dr. S. L. Sharma (P. H. Services) absent	
Dep. Dir. of P. H. for malaria	Dr. B. K. Vaid	Oct. 25-29
	Dr. P.N. Bannerji—zonal officer Gwalior zone	
	Dr. S.L. Khosla—zonal officer Jabalpur zone	

Field Observations

Date	*Unit*	*Sub-unit*	*Locality*	*Activities Observed*			
				Hqs.	*Spraying*	*Surv.*	*Ent. Coll.*
Oct. 25	Indore	—		x			
	Indore	Indore		x		x	x
	Indore	Indore	Kanadia		x		

				Hqs.	*Spr.*	*Surv.*	*Ent. Coll*
Oct. 26	Khandwa			x			
		Knandwa		x			
		Burhampur	Asir		x		
			Chandmi				x(outdoor)
Oct. 27	Ratlam	Mahidtur	Rojwas	—		x(Calibration)	
	Rajgarh		Rajgarh	x			x(satisfactory)
	Guna	Guna	Guna	x			x(not well organized)
		Guna		x			
Oct. 28	Shivpuri		Shivpuri	x			
	Gwalior	x	Gwalior	x (shop)			
	,,	x		x			
	Moreno	x		x			

Special local Problems and/or general comments :
Program now completing 2nd year of coverage under NMEP plan. Indore unit deficient—slides unstained for 10 days. Surveillance workers just beginning to work. Delay in distributing slides. Office hours 11-5 p.m. 2 milion population in problem and difficult areas are scattered among 7 of the 30 units of the State and no plan is made for surveillance. Mass surveys have been inadequate to date. Lab. not organized in advance to cope with the expected Surveillance slides (Khandwa). Highly suggestive evidence of resistance to DDT by **A. culicifacies** in Burhampur sub-unit of Khandwa unit. Only 49% mortality (against 2% DDT paper and only 75% against 4% control 3.75% mortality) these were indoor captures (Sep. 7-12). MLC=2.1. In Dahnala village man hr. density of 35.0 **A. culicifacies**; in Hasanpur and Asir it was 29.8 and 40.3 per man hr. No central laboratory—5% to region or malaria institute not all complied.

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SUMMARY OF DATA FOR THE STATE OF MADRAS WITH HEADQUARTERS AT MADRAS

Visit made from Oct. 19 to Oct. 22 by Team Member : D. J. Pletsch.
No. of State Sub-divisions ("Zones" or "Regions") : 3

Population	*State Total*	*At Risk*
in 1951	29,974,936	28,500.000
in 1959 (est.)	34,400,000	32,000.000

No. of malaria units (1960-61): Endemic 3.7; Hypoendemic, 27.75; Total, 31.45

Summary (Quantitative) of Spraying since Initiation of Eradication Program

	Endemic units	*Hypoendemic units*	*All units*
Houses reached (1959-60)	—	—	6,391,848
Percentage suprayed in:			
1958-59 ROUND I	91.7%	—	91.7%
ROUND II	79.8%	—	79.8%
1959-60 ROUND I	(Data not separated)		93.9%
ROUND II	"		96.9%
1960-61 ROUND I	(Complete data not available)		

Consumption of Insecticides (All figures in long tons)

	DDT 75%	*BHC*
Amount used in 1958-59	264 L.T.s	
Amount used in 1959-60	1,248 L.T.s	
Amount used in 1960 (Rd.I)	1,198.5 L.T.s	
Stock position Oct. 1, 1960	441.5 L.T.s	13.4 L.T.s.

Vehicles and Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated (Not yet received)*
Jeep Station wagons	1	—
Jeep ¼ ton	31	5
Jeep trucks	116	—
Dodge trucks	—	—
Dodge power wagons	16	—
Others	—	—
TOTALS	164	5

Vehicle maintenance facilities : Yes, staffed with mechanical engineers. Central shop plus 3 regional shops.

Sprayers on hand : Stirrup pumps : 3,166
Hand compression : 1,726

Does State Malaria Service have central shop for sprayer repair and/or reconditionig? No.

ASSESSMENT

Entomological Assessment Activities

At State Level

Personnel Entomologists : Sr. 18; Jr. 3 (serving as Unit officers)

No. of villages in which adult susceptibility tests have been accomplished since January 1, 1960 : ? Total tests performed : ?

Malariometry
"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions each type*	*Total No. of blood films submitted, by institutions of each type, during period Sep. 1, 1959 to Aug. 31, 1960*
Base hospitals District hospitals Dispensaries Primary H. centers Others	707	7,073 slides all taken by State Malaria Service personnel posted to OPD line-ups at times. 144 positives obtained.

"Active" Surveillance Field Surveillance Personnel (As of Oct. 1, 1960)

Category of employee	*No. sanctioned*	*No. trained*	*No. actually at work in field.*
Surveillance Inspectors	750	750+	750+
Surveillance workers	3100	4200	3100

Number (and percentage) of units fully staffed and in field operation as of Oct. 1, 1960 : No. 31.45; % of total units : 100%.
Surveillance field workers have been working since late April.
Surveillance inspectors have been working since September.

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBER

	Name	*Date*
NMEP Regional Officer.	Dr. R. Bhombore (Coonoor)	Oct. 19-22
Minister of Health (State).	—	
Diretor of Pub. H. (State).	Dr. Parthasarathy	Not met.
Dep. Dir. of P. H. for Malaria	Dr. P. G. Kesavalu	Oct. 19-22

Field Observations :

Date	*Unit*	*Sub-unit*	*Locality*	*Activities observed*			
				Hqs.	*Spraying*	*Surv.*	*Ent. Coll.*
Oct. 20	State Officer		Madras City	*	—	—	—
Oct. 21	Saidapet	Ennore	Ennore	*	—	—	—
,,	,,	,,	Thiruvettiyur	—	*Ind@	x	—
,,	,,	,,	Thirupallaivanan	—	*	*	—
Oct. 22	,,	—	Saidapet	*	—	—	—

@Indirect; inspection of previously sprayed houses

Special local problems and/or special comments :
State malaria organization has two echelons ("Supervisory unit officer" and

"Special supervisory unit officer") between unit officers and state chief. Entomologists serve as unit officer.

Bed bug resistance, or fear of it, is causing high refusal rates in some areas.

Incentive pay scales have been established for surveillance workers covering difficult areas.

Special kits for surveillance workers have been made up using modified cigar boxes.

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SUMMARY OF DATA FOR THE STATE OF MAHARASHTRA WITH HEADQUARTERS AT POONA.

Visit made from Oct. 2 to Oct. 6 by Team members: E.H. Hinman, F.E. Gartrell, and D. J. Pletsch.

No. of State Sub-divisions ("Zones" or "Regions") : 4

Population	*State Total*	*At Risk*
in 1951	32,007,712	32,007,712
in 1960 (est.)	34,000,000	34.000,000

No. of malaria units (1960-61) : Endemic, 23; Hypoendemic, 10; Total, 33.

Summary (Quantitative) Of Spraying since Intitation Of Eradication Program.

		Endemic Units	*Hypoendemic Units*	*All Units*
Houses reached (1959-60)		5,685,198	1,611,597	7,266,795
Percentage sprayed in :				
1958-59	ROUND I	Figures not readily available		88.5
	ROUND II			88.5
1959-60	ROUND I			91.5
	ROUND II			91.5
1960-61	ROUND I			96.5*

*Exclusive of Bombay city and municipal areas.

Consumption Of Insecticides (All figures in pounds)

	DDT Tech.	*DDT 75%*	*DDT 50%*	*BHC*	*DLN 50%*	*DLN 75%*
Amount used in 1958-59.	192,978	2,802,463	—	180,323	20,495	2,650
Amount used in 1959-60.	208,443	3,820,806	4,480	150,260	137	—
Amount used in 1960 (Rd. I).	1,113,486	2,270,732	2,408	192,267	77	—
Stock position Oct. 1, 1960		(not yet available)				

Vehicles and Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated Not yet received*
Jeep station wagons	1	—
Jeep ¼ ton	41	8
Jeep trucks	91	3
Dodge trucks	41	—
Dodge powers wagons	25	—
Others	—	—
TOTALS	199	11

Vehicle maintenance facilities : None.

No. of sprayers on hand : Stirrup pumps : 3,858; Hand compression : 1,009.

Does State Malaria Service have central shop for sprayer repair and/or reconditioning ? No

ASSESSMENT

Entomological Assessment Activities

At State Level

Personnel Entomologists : 1 sr., 5 Jr.,; Insect Collectors : 8

No. of villages in which adult susceptibility tests have been accomplished since January 1, 1960 : 60 or more (simplified test against 2% DDT papers)

Malariometry

"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submitted, by institutions of each type, during period Sep. 1, 1959 to Aug. 31, 1960*
Base hospitals	—	April 1959 to
District hospitals	109	March, 1960 = 4,099
Dispensaries	378	April, 1960 to
Primary H. centers	53	Aug. 1960 = 1,345
Others	305	
TOTALS	845	

"Active" Surveillance Field Surveillance Personnel (As of Oct. 1, 1960)

Category of employee	*No. sanctioned*	*No. trained*	*No. actually at work in field*
Surveillance Inspectors	850	(see under	0
Surveillance workers	3,400	training)	0

Number (and percentage) of units fully staffed and in field operation as of Oct. 1, 1960 : No. 0; % of total units : 0

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBERS

	Name	*Date*
NMEP Regional Officer :	Dr. J. Rahman	Oct. 2-11
Minister of Health (State) :	Homi Talyerkhan	Oct. 3
Director of Pub. H. (State) :	Dr. J. K. Adranvala	Oct. 3-4
Dep. Dir. of P.H. for Malaria :	Dr. T. Ramachandra Rao	Oct. 2-6

Field Observations:

Date	*Unit*	*Sub-unit*	*Locality*	*Activities observed*			
				Hqs.	*Spraying*	*Surv.*	*Ent. Coll*
2/10/60	Zone office	—	Thaua	x	—	—	—
„	Thana I	—	Thana	x	—	—	—
„	Thana I	Thana	Thana	x	—	—	—
„	Thana II		Kalhar	—	x	—	(+bedbugs)
„	Pen		Khapoli		x		
3/10/60	State Office	—	Poona	x	—	—	—
„	Regional (Poona)		Poona Div.	x			
„	Muncipal Coord.—		Poona	x			
„	Poona I	—	Vithalwadi	—	—	—	x Special outdoor
4/10/60	Sangamner	Manchar	Peth	—	x	—	—
„	„	Junnar	Bota	—	x	—	—
„	„	„	Chaddanapuri	—	—	—	x
„	Sangamner	—	Sangamner	x	—	—	—
„	„	Sangamner	„	x	—	—	—
5/10/60	Aurangabad	—	Aurangabad	x	—	—	—
„	Nasik	Niphad	Yeola	—	x	—	x
6/10/60	„	—	Nasik	x	—	—	—
„	„	Nasik	Sindha	—	x	—	—

Special local problems and/or general comments:

Bedbug resistance is causing refusal problem; diazinone spraying against bedbugs is being done selectively on trial basis.

Migratory populations, principally those associated with public works projects. Bifurcation of Bombay State produced administrative complications in early 1960.

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SUMMARY OF DATA FOR THE STATE OF MYSORE WITH HEADQUARTERS AT BANGALORE

Visit made from Oct. 15 to Oct. 20, 1960 by Team Members : Drs. E.H. Hinman D. Pletsch and Mr. F.E.Gartrell.

No. of State Sub-divisions ("Zones" or "Regions") : 2 Zones (proposed)

Population	*State Total*	*At Risk*
in 1951	19,401,193	19,401,193
in 1960 (est.)	21,826,942	21,826,942

No. of Malaria units (1960-61) : Endemic, 14.63; Hypoendemic, 4.5; Total, 19.13

Summary (Quantitative) Of Spraying since Initiation of Eradication Program

	Endemic units	*Hypoendemic units*	*All units*
Houses reached (1959-60)	3,545,452	989,931	4,535,383
Percentage sprayed in:			
1958-59 ROUND 1	89.9	not func-	89.9
ROUND II	87.7	tioning	87.7
1959-60 ROUND I	87.3	90.6	88.0
ROUND II	88.5	73.7	88.1
1960-61 ROUND I (Up to end of July '60)	86.2	86.8	86.2

Consumption of Insecticides (All figures in pounds)

	DDT Tech.	*DDT 75%*	*DDT 50%*	*BHC*	*DIELDRIN 50%*	*DIELDRIN 75%*
Amount used in 1958-59	141	1,754,964	245,321	89,006	3006	—
Amount used in 1959-60	2856	2,008,279	472,663	72,011	13800	2710
Amount used in 1960 (Rd.I)	—	1,069,727	225,323	156	11511	—
Stock Position Oct. 1, 1960	4	2,343,763	320,147	2,062	35	—

Vehicles And Equipment

Vehicles on hand	*On hand Oct. 1 1960*	Allocated (*Not yet received*)
Jeep Station wagons	2	—
Jeep ¼ ton	19	15
Jeep trucks	45	1
Dodge trucks	9	—
Dodge power wagons	20	—
Others	28	—
TOTALS	121	16

Vehicle maintenance facilities : Yes
No. of Sprayers on hand : stirrup pumps : 1,990; Hand compression: 936
Does State Malaria Service have central shop for sprayer repair and/or reconditioning? Yes

ASSESSMENT

Entomological Assessment Activities
At state Level

Personnel : Entomologists : 12 ; Insect Collectors : 30
No. of villages in which adult susceptibility tests have been accomplished since January 1, 1960 : **None.** Total tests performed: **None.**

Malariometry
"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submitted by Institutions of each type, during period Sep.1,1959 to Aug.31,1960*		
		No. examined	*No. positive*	*%age*
Base hospitals	—			
District hospitals	178	629	629	5
Dispensaries	707	7,592	7,592	77
Primary H. Centers	334	12,679	12,554	93
Others	—	402,036	366,086	527
TOTALS	1,219	422,936	386,861	702

"Active" Surveillance: Field Surveillance Personnel (as of Oct.1, 1960)

Category of employee	*No. Sanctioned*	*No. trained*	*No. actually at work in field*
Surveillance Inspectors	Not yet sanctioned		
Surveillance workers	1,972	2,288 (incl. 316 Health Inspectors)	2,288

Number (and percentage) of units fully staffed and in field operation as of Oct.1, 1960: No. 19.13; % of total units, 47.6
Note'— All the units are fully staffed except 11 units (on the day of evaluation) which have to be posted with the medical officers of health.

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBERS

	Name	*Date*
NMEP Regional Officer	Dr. S. R. Bhombore	Oct. 15-20, 1960
Minister of health (State)	Shri K. K. Hegdge	Oct. 19
Director of Pub. H. (State)	—	—
Dep. Dir. of P. H. for Malaria	Dr. H. Sharma Sastry	Oct. 15-20

Field Observations :

Date	*Unit*	*Sub-unit*	*Locality*	*Hqs.*	*Activics Observed* *Spraying*	*Surv.*	*Ent. Coll.*
Oct. 16	Bangalore	Ramanagram	Ramanagram	x	—	x	—
"	Mandhya Mal. Investig. Center		Mandhya	x	—	—	—
"	WHO ATME		Mysore	x	—	—	—
"	Mysore	—	Mysore	x	—	—	—
Oct. 17	Mysore	Krishnarajanagar	Krishnarajanagar	x	—	—	—
"	Chikmagalur	Belur	Nagathaly	—	xInd*	—	—
"	"	—	"	x	—	—	—
"	Bhadra Reservoir Project, near Bhadravathy			x	—	—	—
"	Shimoga	—	Shimoga	x	—	—	—
"	Sharavathy Valley Hydroelectric Project			x	—	—	—
"	S. V. H. P.	—	Lingamaki	—	—	x	
"	"	—	Butapa Colony	—	xInd*	—	—

Ind*: Spray deposits inspected

Special local problems and/or comments:

Problems include Nomadism, sericulture and "sporadic" outbreak

Many malaria service officers are doubling as district health officers, or vice versa.

Many Sanitary inspectors in "Mysore style" health centers are doing surveillance work

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SUMMARY OF DATA FOR THE STATE OF ORISSA WITH HEADQUARTER AT CUTTACK

Visit made from October 31, 1960 to November 1, 1960 by Team Member : F. E. Gartrell

No. of State Sub-divisions ("Zones" or "Regions") :

Population	*State Total*	*At risk*
in 1951	14.6	14.6
in 1960 (est.)	16.4	

No. of Malaria units (1960-61). Endemic : 13.5; Hypoendemic : 1; Total : 14.5.

Summary (Quantitative) of spraying Since initiation of Eradication Program

	Endemic units	*Hypoendemic units*	*All units*
Houses reached (1959-60)	2,917,045	308,358	3,225,303
Percentage sprayed in :			
1958-59 ROUND I	95%	95%	95%
ROUND II	92%		92%

1959-60	ROUND I	92%	83%	91%
	ROUND II	91%	64%	84%
1960-61	ROUND I	86%		86%

Consumption of Insecticides (All figures in pounds)

	DDT Tech.	*DDT 75%*	*DDT 50%*	*BHC 7.5Y*	*Dieldrin 50%*
Amount used in 1958-59	x	1,504,298	133,333	254,939	181,159
Amount used in 1959-60	x	2,072,070	150,354	913	2,598
Amount used in 1960 (Rd.I)	x	949,974	137,030	287,536	
Stock position Oct. 1, 1960		1,050,922	945,751	440,860	

Vehicles and Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated (not yet received)*
Jeep Station wagons	1	x
Jeep ¼ ton	15	1
Jeep trucks	28	x
Dodge trucks	3 (1 damaged)	x
Dodge power wagons	39 (3 damaged)	x
Others		
TOTALS	86	1

Vehicle maintenance facilitities : Done through Dept. of Health Services.

No. of Sprayers on hand : Stirrup pumps : 1404 (204 unserviceable)
Hand compression : 702 (202 unserviceable)

Does State Malaria Service have central shop for sprayer repair and/or reconditioning? No.

ASSESMENT

Entomological Assessment Activities

At State Level

Personnel Entomologists : **1** Insect Collectors : **0**

No. of villages in which adult susceptibility tests have been accomplished since January, 1, 1960 : **0**
Total tests performed : **0**

Malariometry

"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submitted, by institutions of each type, during period Sep. 1, 1959 to Aug. 31, 1960*
Base hospitals	1	0
District hospitals	152	0
Dispensaries	217	0
Primary H. Centers	72	0
Others	160	0
TOTALS	602	0

"Active" Surveillance Field Surveillance Personnel (As of Oct. 1, 1960)

	No. sanctioned	*No. trained*	*No. Actually at work in field*
Surveillance Inspetors	337		0
Surveillance workers	1350	787 under training	0

Number (and percentage) of units fully staffed and in field operation as of Oct. 1, 1960 : No. 0; % of total units : 0.

PRINCIPAL CONTACTS ESTABLISHED AND ACTIVITIES BY TEAM MEMBER

	Name	*Date*
NMEP Rigional Officer :	Dr. A. K. Chakravarti	31/10 60-1 11/60
Jt. Director of Health Ser.:	Dr. N. Pattanayak	31/10/60-1/11/60
Dep. Dir. of P. H. for Malaria:	Dr. S. K. Mitra	31/10/60-1/11/60

Field Observations :

				Activites observed			
Date	*Unit*	*Sub-unit*	*Locality*	*Hqs.*	*Spraying**	*Surv.***	*Ent. Coll*
31/10	Cuttack	Cuttack	Cuttack	x		x	
1/11	Puri	Puri	Puri	x		x	
			Kanapur Vill.		x		
			Dighala Vill.		x		

* Inspection made of houses sprayed in July and subsequently replastered inside and out.

**Active surveillance not yet underway. Plans were received and discussed. Staff sanctioned in all units. Staffing complete and training in progress in seven units.

Special Problems and/or general comments :

In Puri unit, sub-units are assigned to Medical officers of the 3 Filaria Units operating in that district, and State NMEP Officer compiles unit reports. The state officer supervises the Cuttack unit. In Khurda and Ronpur units, NMEP unit is under supervision of the Filaria Unit Medical Officer. The state organization is being reorganized. There will be initially 2 zonal offices established with 5 or 6 units each. Remainder of units will be under supervision of state NMEP officer until a third zone can be established.

In coastal plains areas (5 units) the following problems are encountered: (1) bedbug nuisance and non-abatement of mosquito nuisance **culicine** and **A. subpictus** which are given as reasons for refusals for spraying and (2)

frequent replastering and/or washing of walls. Problems in inland plateau areas (5.5 units) are natural hazards of terrain for communication and transport and frequent replastering and washing of walls. In inland plains areas (4 units) the special problems are refusals due to non-abatement of mosquito nuisance, lack of local labor, and frequent replastering or washing of walls.

Supervision of field operations in many of the units is especially difficult because of the size of the areas involved. Five of the fifteen units serve areas in excess of 5000 square miles. Establishment of additional units to overcome this difficulty would appear to be desirable.

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SUMMARY OF DATA FOR THE STATE OF PUNJAB WITH HEAD QUARTERS AT KARNAL

Visit made from November 1 to November 2 by team members: E.H. Hinman and Thomson

No. of State Sub-divisions ("Zones" or "Regions") : 2

Population	*State Total*	*At Risk*
in 1951	16,141,205	16,084,381
in 1960 (est.)	18,078,150	18,014,506

No. of Malaria units (1960-61) Endemic, 11; Hypoendemic, 7; Total, 18

Summary (Quantitative) of spraying since initiation of Eradication Program

		Endemic units	*Hypoendemic units*	*All units*
Houses reached (1959-60)		2,050,455	1,113,826	3,164,281
Percentage sprayed in :				
1958-59	ROUND I	86.28	—	86.28
	ROUND II	47.00	—	47.00
1959-60	ROUND I	95.56	95.08	95.45
	ROUND II	72.45	—	72.45
1960-61	ROUND I	97.26	98.55	97.90

Consumption of Insecticides (All figures in pounds)

	DDT Tech.	*DDT 75%*	*DDT 50%*	*BHC*
Amount used in 1958-59	0	1,081,466	712,968	155,660
Amount used in 1959-60	0	2,184,752	1,077,776	21,436
Amount used in 1960 (Rd. I)	0	1,785,212	380,858	0
Stock position Oct. 1, 1960	0	603,526	6,291	50,576

Vehicles and Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated (Not yet received)*
Jeep station wagons	2	—
Jeep ¼ ton	20	9
Jeep trucks	54	—
Dodge trucks	17	—
Dodge power wagons	15	—
Others	4	—
TOTALS	112	9

Vehicles maintenance facilities : None

No. of sprayers on hand : Stirrup pumps : 659

Hand Compression : 324

Does State Malaria Service have central shop for sprayer repair and or reconditioning? Yes.

ASSESSMENT

Entomological Assessment Activities

At State Level

Personnel Entomologists, 1; Insect Collectors, 2

No. of villages in which adult susceptibility tests have been accomplished since January 1, 1960 : **None**

Malariometry

"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submitted by institutions of each type, during period Sep. 1, 1959 to Aug. 31, 1960*
Base hospitals	2	0
District hospitals	167	568
Dispensaries	359	507
Primary H. centers	145	57
Others	139	32
TOTALS	812	1164

"Active" Surveillance Field Surveillance Personnel (as of Oct. 1, 1960)

Category of employees	*No. sanctioned*	*No. trained*	*No. Actually at work in field*
Surveillance Inspectors	425	340	246
Surveillance workers	1,700	1,261	1,261

Number (and percentage) of units fully staffed and in field operation as of October 1, 1960 :

No. % of total units	For all the 17 Surveillance units appointment orders to 1700 Surveillance workers and 425 Surveillance Inspectors have been issued. Out of these 75% of the personnel has reported so far. The steps are being taken again to fill up the remaining vacancies in these Units.

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBERS

	Name	*Date*
NMEP Regional Officer	Dr. Bhatia	Nov. 1-2
Secretary of Health (State)	Mr. S. S. Grewal	Nov. 2
Director of Res. & Med. Educ.	Dr. Tulsi Das	Nov. 2
Dep. Dir. of P. H. for Malaria	Dr. B. P. Sharma	...
	Dr. Gobindram-Northern zone (Jullundur)	
	Dr. S.P. Bahel-Southern zone (Hissar)	

Field observations :

				Activities observed			
Date	*Unit*	*Sub-unit*	*Locality*	*Hqs.*	*Spraying*	*Surv.*	*Ent. Coll.*
Nov. 1	State headquarters		Karnal	x		x	x
	Karnal			x		x	
	„	Karnal	Karnal	x			
	Ambala		Ambala	x		x	x
	Ambala	Ambala	Ambala	x			
Nov. 2	Patiala			x		x	
	„	Rajpura	Almbur			x	

Special local problems and/or general comments :

All spraying in State already completed

All endemic units sprayed in 1958

All endemic and hypoendemic units sprayed in 1959 and 1960

Apparent elimination of **A. culicifacies**, based on census just completed.

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SUMMARY OF DATA FOR THE STATE OF RAJASTHAN WITH HEADQUARTERS AT JAIPUR

Visit made from Oct. 30 to Oct. 31, 1960 by Team Members : E. H. Hinman and Jim Thomson

No. of State Sub-divisions ("Zones" or "Regions") :. 3

Population	*State Total*	*At Risk*
in 1951	15,970,774	15,970,774
in 1960	18,300,000	18,300,000

No. of Malaria Units : (1960-61) : Endemic, 10 ; Hypoendemic, 6.76, Total, 16.67

Summary (Quantitative) of Spraying since initiation of eradication Program.

		Endemic units	*Hypoendemic units*	*All units*
Houses reached (1959-60)		2,332,701	1,136,585	3.469,286
Percentage sprayed in :				
1958-59*	ROUND I	—	—	89.5
	ROUND II	89.6	—	89.6
1959-60	ROUND I	81.6	90.2**	84.5
	ROUND II	89.7	88.0**	61.3
1960-61	ROUND I	97.5	92.9	96.5

*Classification of units was not made before 1959

**Mopping operations only

Consumption of insecticides (All figures in pounds)

	DDT. Tech.	*DDT. 75%*	*DDT. 50%*	*BHC*	*Total*
Amount used in 1958-59					891,853
Amount used in 1959-60					2,614,829
Amount used in 1960 (Rd. I)					1,218,992
Stock position Oct. 1, 1960					

Vehicles and equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated (not yet received)*
Jeep station wagons	1	—
Jeep ¼ ton	18	5
Jeep trucks (Pick up)	40	—
Dodge trucks	—	—
Dodge power wagons	29	—
Others	—	—
TOTALS	88	5

Vehicle maintenance facilities : One shop for minor repairs at Ajmer. It is proposed to be strengthened. Repairs work is done from State Motor Garages.

No. of Sprayers on hand : Stirrup pumps, 1,084 ; Hand Compression : 942
Does State Malaria Service have central shop for sprayer repair and/or reconditioning ? —

ASSESSMENT

Entomological Assessment Activities
At State Level

Personnel Entomologist : 1, Insect Collectors : 3

No. of villages in which adult susceptibility tests have been accomplished since January 1, 1960 4

Total test performed : 10 (with WHO kits)

Malariometry

"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submitted, by institutions of each type, during period Sept. 1, 1959 to Aug. 31, 1960*
All hospitals	258	(
Dispensaries	207	(
Primary H. Centers	135	(7451
Others	—	(Positive in percent 0.13%
TOTALS	600	7451

"Active" Surveillance Field Surveillance personnel as of Oct. 1, 1960

Category of employee	*No. sanctioned*	*No. trained*	*No. actually at work in field*
Surveillance Inspectors	425	350	350
Surveillance workers	1,700	1,700	—

Number (and percentage) of units fully staffed and in field operation as of Oct. 1, 1960 : No. 16.67 ; % of total units : 100%.

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBERS

	Name	*Date*
NMEP Regional Officer :	Dr. J. Rahman	Oct. 30-31
Sec. of Health (State) :	Mr. V.D. Sharma	Oct. 31
Director of Pub. H.&M.S. (State) :	Dr. B.N. Sharma	Oct. 31
Dep. Dir. of P.H. for Malaria :	Dr. B.L. Mathur	Oct. 30-31

Field Observations :

Date	*Unit*	*Sub-unit*	*Locality*	*Activities observed*		
				Hqs.	*Spraying*	*Surv. Ent. Coll.*
Oct. 30	Udaipur	Udaipur	Udaipur	x	x	None
Oct. 31	Jaipur	Jaipur	Jaipur	x	x	None
	Jaipur	Jamba Rambreh	Naila		x	
	Ajmer	Ajmer	Ajmer	x	x	

Special local problems and/or general comments

Excellent young malaria medical officers—all posts filled—about 10 tests made with **A. Culicifacies** and no evidence of resistance, by means of WHO kits. Surveillance recently organized—first round census occupied about 6 weeks.

State reported over 36,000 clinically diognosed cases of malaria in 1959 — unconfirmed.

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SUMMARY OF DATA FOR THE STATE OF UTTAR PRADESH WITH HEADQUARTERS AT LUCKNOW

Visit made from Oct. 30 to Nov. 2, 1960 by Team members: E.H. Hinman, F. E. Gartrell and D.J. Pletsch.

No. of State Sub-divisions ("Zones" or Regions') : Five

Population	*State Total*	*At Risk*
in 1951	63,250,000	61,000,000
in 1960 (est.)	69,250,000	67,000,000

No. of Malaria Units (1960-61) : Endemic, 40; Hypoendemic, 27; Total, 67.

Summary (Quantitative) Of Spraying since Intitation Of Eradication Program

		Endemic units	*Hypoendemic units*	*All units*
Houses (or structures) reached				
1959-60	ROUND I	8,036,253	4,909,170	12,945,423
	ROUND II	8,141,878	—	8,141,478
Percentage sprayed in :				
1958-59	ROUND I	87.6%	(not yet)	87.6%
	ROUND II	72.2%	(functioning)	72.2%
1959-60	ROUND I	92.6%	89.1%	91.2
	ROUND II	93.9%	—	93.9%
1960-61	ROUND I	94.2%*	(not yet available)	94.2%

*Provisionally for 39 units.

Consumption of Insecticides (All figures in pounds)

	DDT Tech.	*DDT 75%*	*BHC*
Amount used in 1958-59		6,424,505	255,011
Amount used in 1959-60		9,087,132*	
Amount used in 1960 (Rd. I)	Complete figures not yet available		
Stock position Oct. 1, 1960	Not available		

*As reported by State; Center reports 8,429,930 lbs.

Vehicles and Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated (Not yet received)*
Jeep station wagons	2	—
Jeep ¼ ton	67	7
Jeep trucks	186	—
Dodge trucks	16	—
Dodge power wagons	84	—
Others	—	—
TOTALS	355	7

Vehicles maintenance facilities : None

No. of Sprayers on hand : Stirrup pumps : 7236

Hand compression : 3618

Does State Malaria Service have central shop for sprayer repair and/or reconditioning ? No

ASSESSMENT

Entomological Assessment Activities

At State Level

Personnel Entomologists : 1; Insect Collectors : 4.

No. of villages in which adult susceptibility tests have been accomplished since January 1, 1960 : 0. Total test performed : 0

Malariometory

"Passive" Suveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Tatal No. of blood films submitted, by institutions of each type, during period Sep. 1, 1959 to Aug. 31,1960*
Base hospitals	—	"Figures not available"
District hospitals	51	
Dispensaries	869	
Primary H. Centers	456	
Others	358	
TOTAL	1734	

"Active" Surveillance Field Surveillance Personnel (As of Oct. 1, 1960)

Category of employee	*No. sanctioned*	*No. trained*	*No. actually at work in field*
Surveillance Inspectors	1,625	0	0
Surveillance workers	6,500	0	0

Number (and percentage) of units fully staffed and in field operation as of Oct. 1, 1960 : No. 0; % of total units : 0.

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBERS

	Name	*Date*
NMEP Regional Officer	Dr. M. L. Bhatia	Sep, 19-25, 1960
Minister of Health (State)	–	—
Director of Pub. H. (State)	Dr. K. M. Lal	Sep. 24
Dep. Dir. of P. H. for Malaria	Dr. Diwan Chand	Sep. 20-25

Field observations :

				Activities observed			
Date	*Units*	*Sub-unit*	*Locality*	*Hqs.*	*Spraying*	*Surv.*	*Ent. Coll.*
20/9/60	Dehra Dun	—	Dehra Dun	x	—	—	—
,,	,,	Dehra Dun	,,	x	—	—	—
,,		,,	Dudhli	—	x(ind)*	—	—
,,	,,	Rishikesh	Hardwar	—	x	—	—
21/9/60	,,	Dehra Dun	Bhatta	—	x	—	—
22/9/60	Rudrapur	—	Rudrapur	x	—	—	—
,,	Rudrapur	Rudrapur	,,	x	—	—	—
,,	,,	,,	Mohanpur	—	x	—	—
,,	,,	,,	Mazra An.Singh	—	x(ind)*	—	—
23/9/60	,,	Kashipur	Ramnagar	—	x	—	—
24/9/60	Barabanki	—	Barabanki	x	—	—	—
,	,,	Nawabganj	,,	x	—	—	—
,,	,,	Ramnagar	Deoli	—	x	—	—

*Indirectly, by inspection of deposits in villages already sprayed.

Special local problems and/or general comments :

Border areas with Nepal and China, whose eradication programs are not being carried out.

Lucknow area units hampered by flood problems.

SUMMARY OF DATA FOR THE STATE OF WEST BENGAL WITH HEADQUARTERS AT CALCUTTA

Visit made from 24.10.60 to 29.10.60 by Team Member : F.E. Gartrell

No. of State Sub-divisions ("Zones" or "Regions") : Four

Population	*State Total*	*At Risk*
in 1951	24.8 million	22 million
in 1960 (est.)	29.03 million	26 million

No. of Malaria units (1960-61) : Endemic **23** ; Hypoendemic **3** ; Total **26**

Summary (Quantitative) of Spraying since Initiation of Eradication Program

		Endemic units	*Hypoendemic units*	*All units*
Houses (or structures) reached				
1959-60		5,162,682	301,970	5,464,652
Percentage sprayed in :				
1958-59	ROUND I	91.5	92.4	91.5
	ROUND II	88.8	—	88.8
1959-60	ROUND I	95.8	81.4	95.1
	ROUND II	91.6	—	91.6
1960-61	ROUND I	96.3	86.2	96.2

Consumption of insecticides (All figures in pounds)

	DDT Tech.	*DDT 75%*	*DDT 50%*	*BHC*
Amount used in 1958-59	nil	2,595,670	x	406,747
Amount used in 1959-60	nil	3,364,364	x	64,384
Amount used in 1960, (Rd. I)	nil	1,743,107	87,380	5,738
Stock Position Oct 1, 1960 at the end of 1st round	nil	2,149,641	186,420	20,311

Vehicles and Equipment

Vehicles on hand	*On hand Oct. 1, 1960*	*Allocated Not yet received*
Jeep Station wagons	2	nil
Jeep ¼ ton	26	26
Jeep trucks	59	—
Dodge trucks	—	—
Dodge power wagons	36	nil
Others (Studebaker)	55	nil
TOTALS	178	26

Vehicles maintenance facilities: At regional level under the Transport Organization of the Health Directorate.

No. of Sprayers on hand : Stirrup pumps 3150 (serviceable)
Hand Compression 900 (serviceable)

Does State Malaria Service have central shop for sprayer repair and/or reconditioning? No, but each unit is provided with one small workshop.

ASSESSMENT

Entomological Assessment Activities

At State Level

Personnel Entomologists : Two ; Insect Collectors : 21

No. of villages in which adult susceptibility tests have been accomplished since January, 1960 : **One**

Total tests performed : **One**

Malariometry

"Passive" Surveillance

Category of Medical Institutions	*No. of existing Institutions of each type*	*Total No. of blood films submitted, by institutions of each type, during period Sept. I, 1959 to Aug. 31, 1960*
Base hospitals	6	nil
District hospitals	15	627
Dispensaries	597	2,232
Primary H. Centers (including Union & Subsidiary Health Centers)	408	1,006
Others	4	—
TOTALS	1,030	3,865

"Active" Surveillance *Field Surveillance Personnel as of Oct. 1, 1960*

Category of employee	*No. sanctioned*	*No. trained*	*No. actually at work in field*
Surveillance Inspectors	547*	0	0
Surveillance workers	2,188*	0	0

Number (and percentage) of units fully staffed and in field operation as of Oct. 1, 1960 : No. nil ; % of total units : 0.

*Closing date for applications October 31, 1960.

PRINCIPAL CONTACTS ESTABLISHED, AND ACTIVITIES, BY TEAM MEMBER

	Name	*Date*
NMEP Regional Officer :	Dr. V. Somasundara Rao	10/24 - 10/29
Secretary, Dept. of Health :	Lt. Gen. D.N. Chakravarti	10/25
Director of Pub. H. (State) :	Lt. Gen. D.N. Chakravarti	10/21
Asst. Dir. of Health Services (Insect Borne Diseases)	Dr. I. N. Ganguli	10/24 - 10/29
Transport Officer :	Mr. D. C. Ghosh	10/26

Field observations :

				Activities observed		
Date	*Units*	*Sub-unit*	*Locality*	*Hqs.*	*Spraying*	*Surv.*Ent. Coll*
10/26	Diamond Harbour	Diamond Harbour	Diamond Harbour	x		x
			Kamarpol Village		x	
10/25	Burdwan (E)	Burdwan (E)	Kalna	x		x
			Dhatrigram Village		x	
10/27	Siligiri		Siligiri	x		
10/28	Jalpaiguri	Jalpaiguri	Jalpaiguri	x		
			Belacola Vill.		x	

*Actual surveillance not yet in operation in any part of the state.
At units indicated, plans for surveillance were rewiewed and discussed.

Special local problems and/or general comments :

External border areas adjacent to countries in which malaria eradication programs are not functioning or are just getting underway, pose a special problem in this State. Due to border problem, no active surveillance set-up is currently planned in these districts and major portions of two other districts in the northern part of State, because there are no prospects for interruption of spraying in these areas.

In the Diamond Harbour area of Calcutta, many areas require water transportation for spray cruise and materials, and for supervision. To meet this problem boat is needed by the malaria unit, because rental of suitable craft frequently cannot be obtained through commercial sources when needed. In the northern part of the state difficult terrain poses problems of transport and communications.

The usual problems of refusals, locked houses, rethatching, washing of walls, and replastering are also encountered. In the Malda District of the Kalliashah area, silk worm culture is so prevalent that no DDT residual spraying is done. In this area surveillance plus drug therapy is employed in lieu of spraying.

Appendix C

BACKGROUND

The Country

The subcontinent of India lies between 8° and 37° 10'' North latitude and between longitudes 68° and 97° 25' East. It measures about 2000 miles from North to South and about 1850 miles from East to West. It covers an area of 1,259,797 square miles and is the seventh largest country in the world. It has a land frontier of 9,425 miles, and a coastline of 3,535 miles.

The mainland comprises three well defined regions: (1) the mountain zone of the Himalayas (2) the Indo-Gangetic Plain and (3) the Southern Peninsula. The Indo-Gangetic Plain is 1,500 miles long and 150-200 miles broad, formed by the basins of the Indus, the Ganga and the Brahmaputra rivers. It is one of the world's greatest stretches of flat alluvium and one of the areas of densest population. There is little variation in relief between Delhi and the Bay of Bengal. In a distance of about 1000 miles there is a drop of only 700 feet. The peninsular plateau is separated from the Indo-Gangetic Plain by mountains and hill ranges varying from 1500 to 4000 feet.

The climate of India is essentially monsoon-tropical with the cold weather from October to the end of February, the hot weather from the beginning of March to the beginning or middle of June, and the rainy season from the beginning or middle of June to the end of September. Regions such as the West Coast, Bengal and Assam have rainfall exceeding 200 cms (80 inches); the North East Plateau and the middle Ganga valley have from 100 to 200 cms. (40 to 80 inches) annually; Madras, Southern and North Western Deccan and the upper Ganga plain average 50 to 100 cms. (20 to 40 inches) of rainfall.

Its People

Current estimates are that the population will exceed 420,000,000 before the end of 1960. Thus India is the second most populous country in the world.

The country is organized into 15 states and a group of union territories. The publication "India, 1960" lists the density of population for the Union as 287 (May 1959) but individual States vary from a low of 51 in Jammu and Kashmir to a high of 903 per square mile in Kerala. The Union territories present greater extremes. Several states exceed 25 million population. Uttar Pradesh approaches 70 million and has a population density of 557 per square mile. Jammu and Kashmir has less than 15 million.

Between 1941 and 1951 births occurred at an average rate of 40 per thousand per annum and deaths at an average rate of 27 per thousand per annum yielding a natural increase of 13 per thousand per annum.

In 1951 it was estimated that 82.7 of the total population was rural, living principally in villages, and 17.3 per cent was urban. There are 3,018 towns and 558,088 villages in India. Twenty six and one half per cent of the rural population lives in villages under 500 persons, 48.8 per cent in medium sized villages (between 500 and 2000 persons), and 19.4 per cent in very large villages. (over 5000). Of the urban population 38.0 per cent lives in cities of 100,000 population (one lakh) or over, 30.1 per cent in major towns (population between 20,000 and 100,000), 28.6 per cent in minor towns (5000 to 20,000), and 3.3 per cent in townships (population under 5000). The 1951 census revealed 73 towns in India with a population of 100,000 or over.

Seventy per cent of the population depends upon agriculture for its livelihood. Out of every 100 Indians (including their dependents) 47 are mainly peasant proprietors, 9 mainly tenants, 13 landless laborers, one a landlord or agricultural renter, 10 are engaged in industries or other non-agricultural production, 10 in commerce, 2 in transport and 12 in the services and miscellaneous professions.

The Malaria Problem of India (Past)

India has been recognized as a notoriously malarious country. As recently as 1952, Jaswant Singh estimated that the annual number of malaria cases approximated 75 million and that out of about 5½ million deaths annually, over one half were due to fever of which about 800,000 were directly attributable to malaria and in an equal number malaria was a contributory cause of death. Very limited areas, except those over 6000 feet above sea level, were free of malaria ten years ago.

Vectors of Malaria in India

Of a total of 44 anopheline species in India only six are regarded as vactor of primary importance :

Anopheles culicifacies is one of the most important vectors in India. It has been responsible for epidemics in north-west and central India and for endemic malaria in the peninsula. On the other hand in Bengal and Orissa it is relatively unimportant. It breeds in sunlit pools, sluggish streams with sandy margins and little vegetation, irrigation channels, rice fields (when fallow), borrow-pits, tanks and reservoirs. The adults rest in cattle sheds and human dwellings and probably feed on man and cattle indiscriminately.

A. **fluviatilis** is an important vector in hyperendemic foothill areas of south and northwest India and in the huge irrigated tracts of the Deccan Plateau. The species breeds in grassy margins of clear slowly moving water, in seepages, irrigation channels, shallow earth wells, terraced rice fields, contour drains and occasionally in margins of swamps. Human dwellings are the usual daytime resting places of the adults although some rest out of doors, under stream banks, on vegetation and stones.

A. **minimus** is a major submontane vector widespread along the foothills of Bengal and Assam, and is responsible for hyperendemic conditions often associated with blackwater fever. Continuous breeding is limited to clear, slow moving water with grassy edges and little shade. Marshes and rice fields are of no importance as breeding places. In North Bengal and Assam, it is a predominantly domestic species sheltering in human habitations, on the lower half of the walls, often on the floor under beds, or on the undersides of beds. The species in north and east India has a definite preference for human blood.

A. **philippinensis** is widely distributed over India but is an important vector only in Deltaic Bengal but not in Assam. The preferred breeding places are "tanks" (reservoirs), permanent weedy pools, overgrown ditches and occasionally rice fields. In Bengal the species has been found resting only in human habitations but in Assam also in cattlesheds. The adults prefer resting on the walls from about 4 feet above the floor, on hanging clothes and other articles. Most of the feeding activity takes place indoors.

A. **stephensi** is a widely distributed species predominantly in the north, west and peninsular India. It is an important vector under rural

conditions in Bombay and Andhra States and of urban malaria in Bombay, Lucknow, Bangalore, Visakhapatnam. It breeds in sunlit wells, cisterns, fountains, margins of sluggish streams, pools, seepages, irrigation channels, reservoirs and springs. It may breed in saline waters and in polluted waters. Its resting places are human dwellings and cattle sheds, often under the eaves, on articles hanging on the walls and in attics where fodder is stored. It probably feeds indiscriminately on man and animals.

A. **sundaicus** is an important vector in West Bengal, Orissa and part of Andhra. This species breeds by preference in brackish water with algae although fresh water breeding has been recorded. The larvae can tolerate heavy organic pollution. The main breeding places are lagoons, salt-swamps, pools behind coastal dykes, but also in tanks, ponds and large borrow-pits. The adults rest in houses and cowsheds, but when high density occurs it may rest out of doors. There is little outdoor feeding.

Appendix D

National Malaria Eradication Program of India

DISTRIBUTION OF VEHICLES

STATE	NUMBER AND TYPES					Total Number units
	TRUCKS			¼ ton Jeeps	Jeep Station Wagon	
	Jeeps	Power wagons	Other			
Andhra Pradesh	111	16	20	33	2	182
Assam	18	30	20	14	1	83
Bihar	117	56	24	42	2	241
Maharashtra	87	34	38	30	1	190
Gujarat	50	17	20	18	1	106
Delhi	4	0	8	2	1	15
Himachal Pradesh	6	2	0	2	1	11
Jammu & Kashmir	4	0	4	2	0	10
Kerala	53	4	6	15	1	79
Madhya Pradesh	66	47	43	29	3	188
Madras	116	10	5	32	1	164
Manipur	3	6	1	3	0	13
Mysore	44	16	43	19	2	124
Orissa	28	34	8	14	1	85
Punjab	54	12	24	18	2	110
Rajasthan	41	28	3	16	2	90
Tripura	2	2	1	2	0	7
Uttar Pradesh	187	80	20	67	2	356
West Bengal	59	24	68	26	2	179
North East Frontier area	6	0	0	1	0	7
Naga Hills	5	0	0	1	0	6
Sikkim	2	0	0	2	0	4
Coalfields	0	0	0	0	0	0
Andaman Nicobar Islands	1	0	0	0	0	1
Malaria Inst.	0	0	1	18	12	31
TOTALS	1064	418	357	409	37	2282

NOTE:—From data supplied by NMEP Central Organization. In addition to the above, 36 Jeeps are in Bombay awaiting assembly and delivery, and 150 have been purchased locally for delivery on or before March 1, 1961 Of these latter vehicles, 50 had been delivered as of October 1, 1960.

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